Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan

Final Environmental Impact Report

Volume I

State Clearinghouse Number 96122077

July 1997

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CHAPTER TWO

DESCRIPTION OF THE PROPOSED PROJECT

2 DESCRIPTION OF THE PROPOSED PROJECT

2-1 PROJECT LOCATION AND LAND OWNERSHIP

2-1.1 Location

Owens Lake is located in Inyo County in eastern-central California. It is situated at the south end of the long, narrow Owens Valley with the Sierra Nevada to the west, the Inyo Mountains to the east, and the Coso Range to the south (Figure 2.1). The predominantly dry, alkaline Owens Lake playa is approximately eight miles south of the community Lone Pine on U.S. Highway 395, 65 miles north of the city of Ridgecrest, twelve miles east of Sequoia National Park, and 35 miles west of Death Valley National Park. The communities of Olancha and Keeler are located on the southwestern and eastern shores of the lake bed, respectively. The lake bed extends about seventeen miles north and south and ten miles east and west and covers an area of approximately 110 square miles (70,000 acres).

Owens Lake and its surrounding dry playa are depicted on the following seven U.S. Geological Survey (USGS) 7.5-minute series topographic quadrangle maps: Lone Pine, Dolomite, Bartlett, Owens Lake, Keeler, Olancha and Vermillion Canyon. These maps are available for review in the District's Bishop office. Site-specific topographic mapping has been compiled and is shown in Figure 2.2.

The Proposed Project will be implemented on about 35 square miles (22,400 acres) of the former lake bed, predominantly in the eastern portion (Figure 2.3). The shaded areas in Figure 2.3 represent PM_{10} source areas that require emission control measures as well as potential pipeline routes. There is one relatively small emissive area, about two miles by ¾ mile in size, located immediately west of the Owens River delta, and one long emissive area, approximately 2½ miles wide by fourteen miles long, located parallel to the historic eastern shoreline.

Figure 2.3 indicates the existing riparian and wetland resources on Owens Lake. Riparian vegetation extends onto the largely barren dry lake bed in the area of the Owens River delta. In addition, a narrow band of vegetation consisting of spring mounds and alkaline meadows is present along the edge of the historic shoreline, above the areas that are the primary sources of PM_{10} emissions. The wetlands shown along the eastern historic shoreline in Figure 2.3 were mapped with a Global Positioning System (GPS). The wetlands shown along the western historic shoreline in Figure 2.3 were mapped from satellite images.

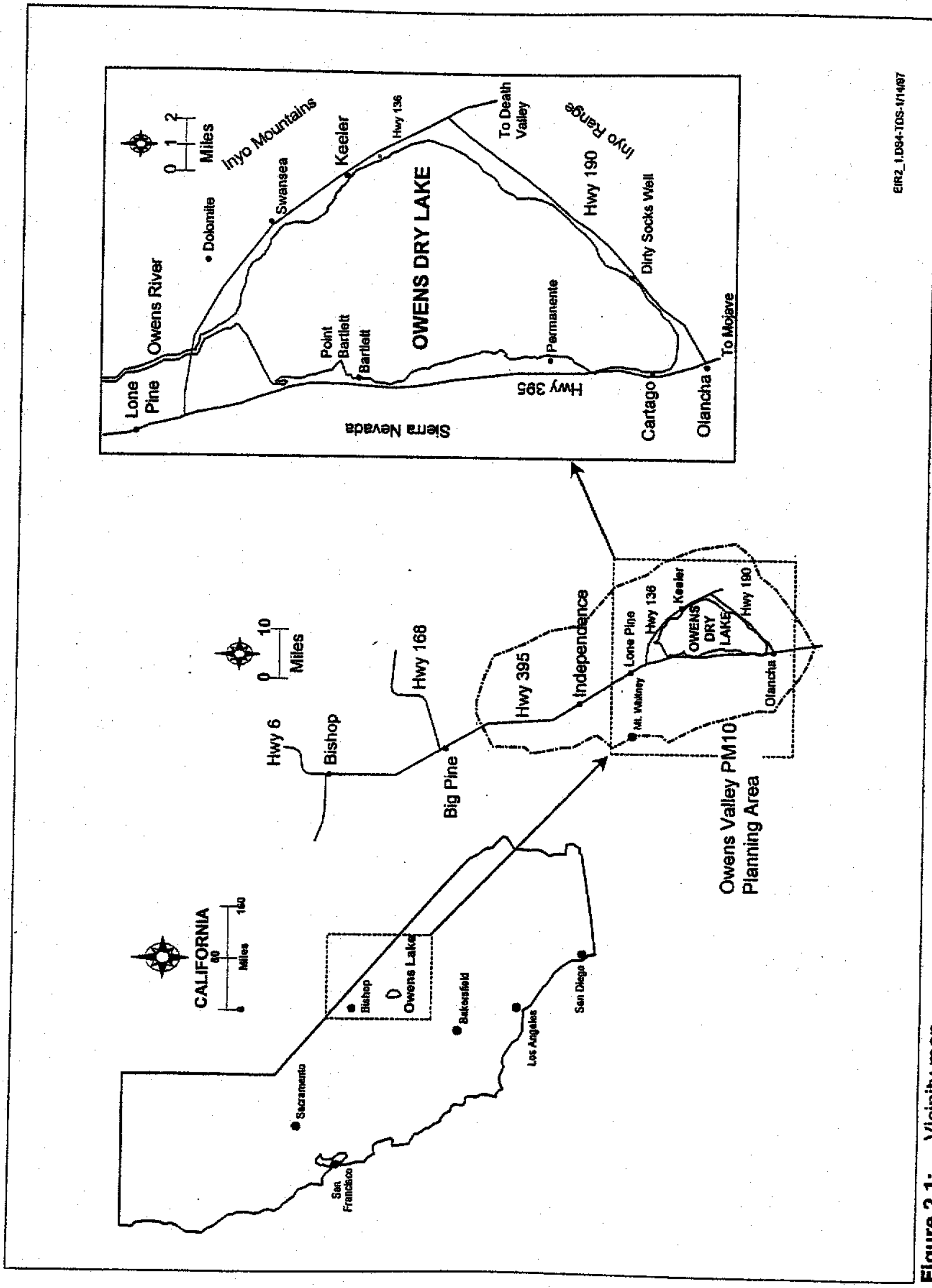


Figure 2.1: Vicinity map.

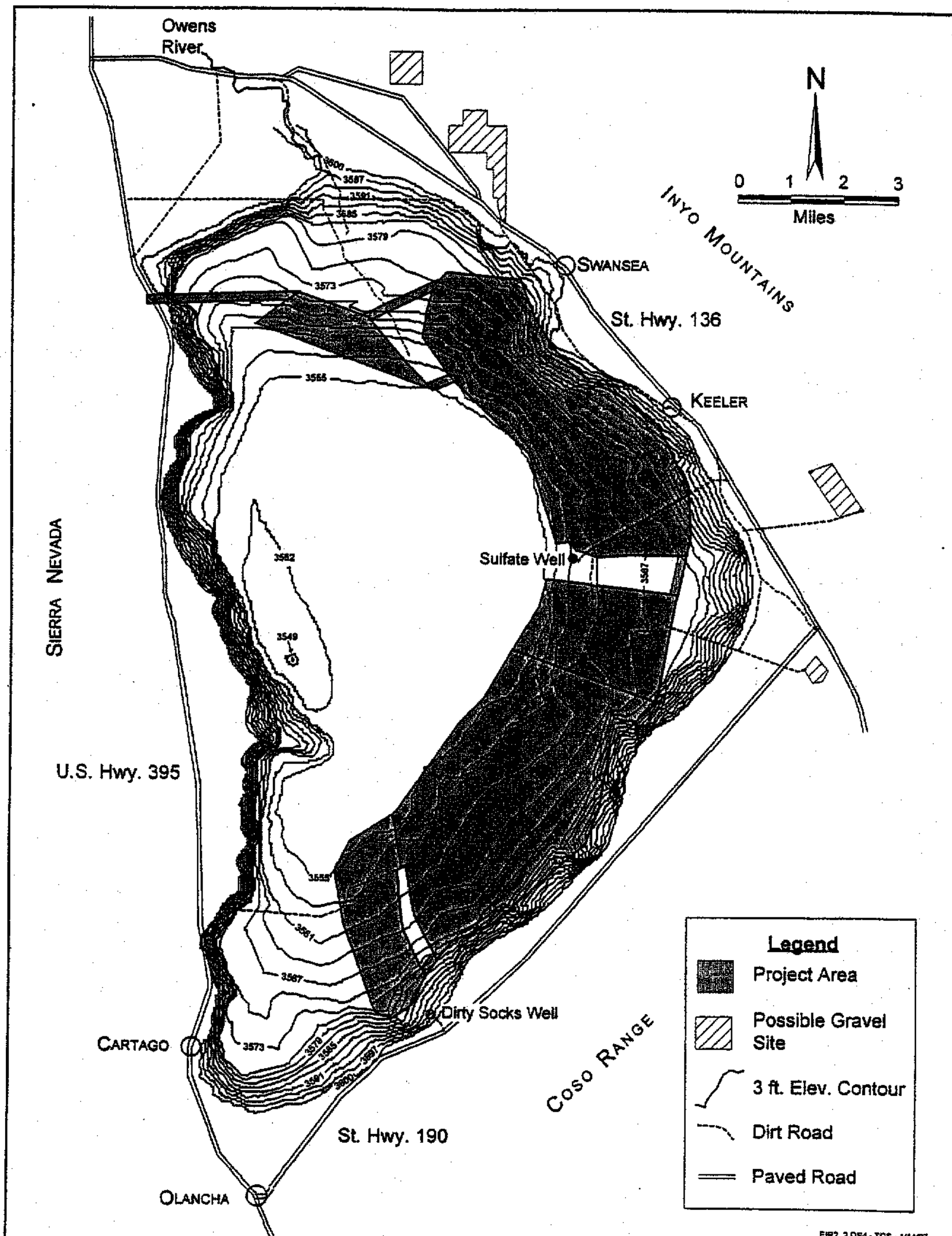
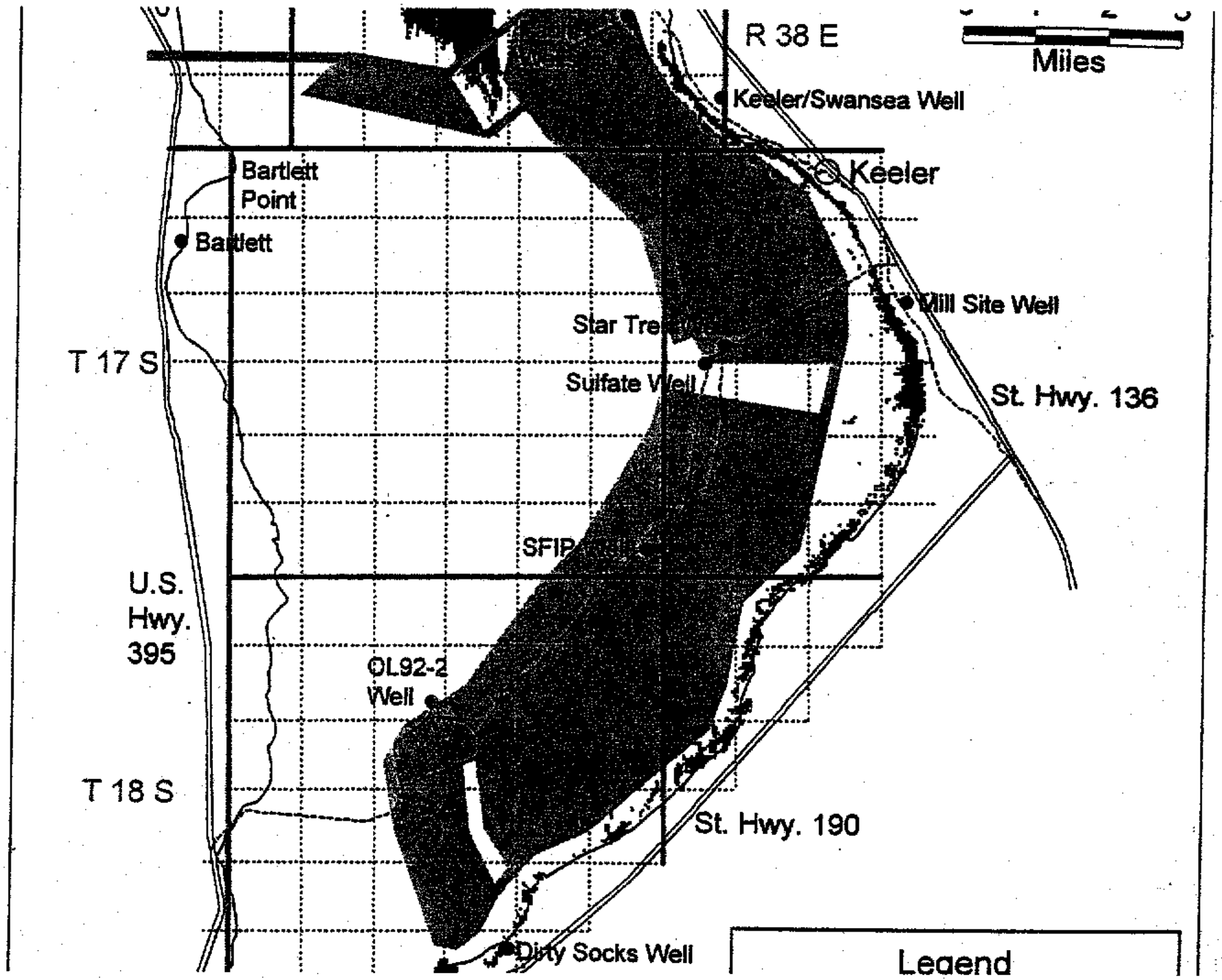


Figure 2.2: Topographic site map



R 38 E
Miles
Keeler/Swansea Well
Keeler
Bartlett Point
Bartlett
Mill Site Well
Sulfate Well
St. Hwy. 136
T 17 S
U.S. Hwy. 395
OL92-2 Well
T 18 S
St. Hwy. 190
Dirty Socks Well
Legend

2-1.2 Land Ownership

Approximately 68,000 acres, or 95 percent, of the Owens Lake bed is owned by the State of California and managed by the SLC. Most of this state-owned land is leased for a variety of purposes. The Owens Lake Soda Ash Company leases 16,120 acres of lake bed for the purpose of extracting trona ore. In addition, there are a few agricultural leases near historic shoreline areas. Most of the remaining lake bed areas are leased from the State by the District for the purpose of developing PM_{10} control measures. The remaining five percent of the lake bed, or approximately 2,800 acres, is owned by the City of Los Angeles; these lands are in the Owens River delta and on the lake bed west of Keeler. Areas above the historic shoreline are either public lands managed by the BLM, or are owned by the State of California, the City of Los Angeles, or private parties. Figures 3.38 and 3.39 show some of the ownership and lease boundaries. All control measures and supporting infrastructure are proposed to be owned by the City of Los Angeles on property owned by the City or on leases or easements from other land owners.

2-2 PROJECT HISTORY

2-2.1 Environmental Setting and Effects of Diversions on Owens Lake

Owens Lake is part of a chain of lakes formed during the late Pleistocene epoch, about 1.8 million years ago. The lakes extended from Mono Lake (previously a much larger lake known as Lake Russell) in the north to Manley Lake, the southernmost of the chain, in what is now Death Valley. During much of this time, water from the Owens Valley basin flowed out of Owens Lake through Rose Valley and into China Lake. The high stand of the lake that produced the shorelines at an elevation of 3,880 feet above mean sea level (all elevations will be given in feet above mean sea level) is estimated to have occurred 15,000-16,000 years ago. Since that time, the surface extent of the water of Owens Lake has been diminishing—although two deep cores on the lake bed have failed to identify any previous episodes of complete desiccation (Smith and Pratt, 1957; and Smith and Bischoff, 1993). Uplift processes in the Coso Range, combined with a post-glacial drying trend, eliminated overland outflow from the basin about 3,000 years ago. As a result, the lake basin became closed, losing water only through surface evaporation and transpiration. This internal drainage, combined with the arid environment, created the highly saline condition of remaining surface waters and playa soils at the bottom of the Owens Valley basin. Even in the 1800's, when it was used as a navigable waterway, Owens Lake was an alkali lake.

Although historic lake levels were as high as 3,597 feet in 1878 (Lee, 1915), surface water diversions over the last 130 years have reduced the lake to less than one-third of its original area and about five percent of its original volume (Mihevc and Cochran, 1992). From the 1860's to the early 1900's, withdrawals from the Owens River for agricultural purposes substantially reduced surface water inflow to the lake. Extensive irrigation projects compounded by drought caused the lake level to drop as low as 3,565 feet in 1906. However, as the drought ended, by 1912 the level had risen to 3,579 feet (Figure 3.15; and Lee, 1915). In 1913, the Los Angeles Department of Water and Power (LADWP) completed a fresh water aqueduct system and began diverting waters of the Owens River south to the City of Los Angeles. Demand for exported water increased as Los Angeles grew, and diversions for irrigation continued in the Owens Valley (mainly on City-owned property). These factors resulted in Owens Lake becoming virtually dry by 1930, its level having dropped to an elevation of 3,554 feet (Saint-Amand, 1986; and LADWP, 1966).

A former or stranded shoreline was left behind at an approximate elevation of 3,600 feet. The former shoreline bounds the playa in aerial photographs and on most maps. Today, a small permanent brine pool is present in the lowest portion of the basin, surrounded by dry playa soils and crusts. The ordinary high water mark of this remnant brine pool has been defined by the U.S. Army Corps of Engineers to be that portion of the lake basin below 3,553.55 feet. Evaporite deposits and brines cover much of the brine pool area; the concentration of dissolved solids (salts) can be as high as 35 percent by weight.

Although limited in distribution at Owens Lake, the Owens Valley has been described as having a very rich variety of plants with over 2,000 species represented in the region (DeDecker, 1984). Riparian, alkaline meadow, and alkali seep plant communities which circumscribe Owens Dry Lake provide important habitat for resident and migratory wildlife species. Many of the diverse wildlife resources that are characteristic of the Sierra Nevada, Inyo, and Coso mountain ranges surrounding Owens Lake will occasionally be found on the valley floor, particularly during winter. Heindel and Heindel (1995) report as many as 320 bird species for the Owens Valley floor including permanent residents, summer residents, winter residents, and migrants. Ephemerally flooded areas in the vicinity of Owens Lake provide excellent resting and foraging habitat for winter migrants and prime opportunities for birdwatching. Several sensitive wildlife resources are found at Owens Dry Lake.

The Owens Valley has attracted the interest of archeologists since at least the 1930's. The Riddells (Riddell, 1951; and Riddell and Riddell, 1956) conducted the major work in the region in the 1940's and 1950's, recording several sites on the perimeter of Owens Lake, including important sites at Cottonwood Creek and Rose Spring. Two California State Historic Landmarks and two California Points of Historic Interest are located in the vicinity of Owens Lake. Ethnographic data indicate that the east shore of Owens Lake was used by Native American groups. Historic resources related to mining and transportation have been identified along the stranded shoreline.

2–2.2 Legal History

By the late 1920's, the majority of the lake bed was dry and remained so until 1937. Valuable mineral deposits of trona ore were exposed and became available for extraction. In 1937, 1938, and 1939, the LADWP released large quantities of water onto the lake bed, causing extensive damage to the mineral deposits and chemical processing plants. In 1937, Natural Soda Products Company, a lessee of mineral rights from the State of California, sued the City of Los Angeles for damages to its chemical plant and business caused by the flooding of Owens Lake. The court decided the case in 1943 and a judgment for damages was awarded. Natural Soda Products Co. vs. City of Los Angeles (1943) 23 Cal.2d 193 143 P.2d 12 established that "the city, by its long continued diversion of the waters of the Owens River, incurred an obligation to continue that diversion . . . at least so long as it continued to maintain its aqueduct." In 1939, the State, as owner of the lake bed, brought an action to define whether the City's obligation could be enforced by injunction, and if so, to determine the extent of the injunction. The trial court, citing the principles set forth in the Natural Soda Products case, later granted an injunction and prohibited the City from: (a) diverting any waters from the Mono Basin watershed into or onto Owens Lake, and (b) diverting any waters of the Owens River and its tributaries into or onto Owens Lake "which are not in excess of an amount equal to the reasonable capacity of [LADWP's] aqueduct system and all of its component facilities reasonably operated." The City of Los Angeles appealed the trial court's injunction.

In 1950, the City's appeal was finally resolved in California Supreme Court People vs. the City of Los Angeles 34 Cal.2d 695 214 P.2d 1. The appellate court modified and affirmed the lower court's decision regarding the injunction. The two significant modifications were as follows. First, because waters of the Mono Basin watershed and Owens Valley waters become mixed, the first part of the injunction was technically unenforceable. It was, therefore, amended to prohibit increasing the natural flow of the Owens River, by diverting into it waters of the Mono Basin, if such a diversion would necessitate the release of water into or onto Owens Lake. Second, the LADWP was found to be under no obligation to spread surplus water onto land owned in the Owens Valley in excess of amounts that could reasonably be used on such land or stored underground for future beneficial use. Importantly, it also reaffirmed that portion of the injunction regarding "diverting any waters out of [LADWP's] aqueduct system onto Owens Lake, or in any way releasing any waters to be deposited into or onto Owens Lake at any time, unless the flow of water of the Owens Valley watershed is in excess of an amount equal to the reasonable capacity of [LADWP's] aqueduct system and all of its component facilities reasonably operated."

By letter to the District, dated February 5, 1997, Michael R. Valentine, Senior Counsel to the California State Lands Commission, stated that, "[i]n the event that the measures ordered by the [Great Basin] District Board are acceptable to the State Lands Commission, the Commission, in addition to approving the leases or permits for the use of the State-owned land on the lake bed, would propose some method to allay any concerns there may be about compliance with the injunction." Specifically, the Commission would commit not to seek judicial enforcement of the order, or could ask the Court to modify the injunction to expressly permit implementation of the air quality control measures.

In 1982, the LADWP applied for a permit with the District to construct and operate a geothermal electric generating plant in the Coso Known Geothermal Area. The permit was denied based on the assertion that LADWP was in violation of air pollution rules and regulations elsewhere in the region. Specifically, the District, pursuant to District Local Rule 200, considered the water-gathering operations of LADWP to be a "facility" indirectly responsible for the particulate emissions from Owens Lake and concluded that an air quality permit was required.

After the District Hearing Board affirmed the denial of the permit, a negotiated settlement emerged in Senate Bill 270 (SB 270) sponsored by Senator Dills in 1983. SB 270 (codified as California Health and Safety Code Section 42316) exempted water-gathering operations from state air quality permit requirements. It provided that the City of Los Angeles must fund control measure development and must implement reasonable measures ordered by the District to attain compliance with the state and federal ambient air quality standards at Owens Lake. By law, the District-mandated control measures may not affect the City's right to produce, divert store or convey water. The control measures described in the Proposed Project have been designed to satisfy the applicable requirements of this statute.

2-2.3 Regulatory History

The OVPA experiences severe dust storms from Owens Lake that are set up by a dynamic interaction of water, salts, temperature, and wind. During wet periods in the winter, precipitation infiltrates lake bed sediments and dissolves surface salts. Evaporation of moisture from the wet surface causes salts to precipitate and, in cooler weather, may result in a fine powdery efflorescence of salt crystals, called salt fluff, over much of the exposed playa soils. During warm weather, a harder salt crust may form. Strong surface winds, associated with winter storm fronts, are channeled by the deep, narrow Owens Valley and can gust up to 65-75 mph. These winds entrain or loft fine-grained particles, including salt fluff, directly into the air. Other salt crusts are eroded by saltation—the abrading, bouncing movement of sand driven by the wind across a surface—or are directly damaged by winds to form sand-sized crust particles. PM_{10} emissions from these dust storms are estimated to range from 130,000 to more than 400,000 tons per year, and the effective "airshed" extends into densely populated sections of Southern California (GBUAPCD, 1997a).

In 1987, the EPA revised the NAAQS, replacing total suspended particulates (TSP) as the indicator for particulate matter with a new indicator called PM_{10}. PM_{10} is defined as particulate matter that has an average aerodynamic diameter less than or equal to ten microns (10 μ). The standard for PM_{10} was set at a concentration of 150 micrograms per cubic meter ($\mu g/m^3$) for the 24-hour average and 50 $\mu g/m^3$ for the annual average. At the same time, EPA set forth regulations for implementing the revised NAAQS, and announced the policy for development of SIPs and supporting control strategies. Also in 1987, EPA designated the OVPA as one of the areas in the nation that violated the PM_{10} NAAQS.

Air quality monitoring by the District has shown that the bed of Owens Lake is the principal source of PM_{10} emissions contributing to violations of the 24-hour standard in the Owens Valley Planning Area. Extremely high PM_{10} concentrations (as much as 25 times the standard) have been verified downwind of Owens Lake. Other sources of PM_{10} in the Planning Area account for approximately one percent of the peak 24-hour PM_{10} emissions (GBUAPCD, 1997a). Inter-basin transfers increasing PM_{10} concentrations in the southern Owens Valley are inconsequential.

Federal law requires the State of California to timely prepare a SIP for the OVPA that demonstrates how PM_{10} emissions will be decreased to comply with the NAAQS. The District is the agency delegated by the State to fulfill this requirement. An initial SIP was prepared by the District in 1988, approved by the California Air Resources Board (CARB), and forwarded to the EPA. No action was taken by the EPA to approve or disapprove. In November 1990, the federal Clean Air Act Amendments (CAAA) were signed into law, setting into motion new statutory requirements for attaining the PM_{10} NAAQS. All areas in the United States that were previously classified as federal non-attainment areas for PM_{10}, including the southern Owens Valley, were designated as "moderate" PM_{10} non-attainment areas. In response to an EPA requirement, in November 1991 the District prepared an addendum to the 1988 SIP that updated the air quality information and the work performed since 1988.

Section 188(b) of the CAAA specified that any area that cannot attain the NAAQS by December 1994 would subsequently be reclassified as a "serious" non-attainment area. In January 1993, EPA completed its initial reclassification process, and included the OVPA among five nationwide areas reclassified as "serious" effective February 8, 1993. Section 189(b) of the CAAA further specified that a SIP revision is due within eighteen months of the reclassification (August 8, 1994). Said revision must assure that implementation of Best Available Control Measures (BACM), including (BACT), will be effective within four years of the reclassification date. A BACM SIP was prepared in June 1994 and approved by the CARB.

The Clean Air Act Amendments require that the PM_{10} NAAQS be attained by December 31, 2001. By February 8, 1997, a PM_{10} Attainment SIP must be submitted to the EPA that (a) includes PM_{10} control strategies, (b) provides air quality modeling that demonstrates attainment of the federal air quality standards from the implementation of these controls, and (c) provides quantitative milestones for "reasonable further progress" reporting to the EPA. If submission of the Attainment SIP is substantially delayed, the federal EPA is authorized to enforce the submittal deadline by requiring the implementation of stricter-than-normal air quality regulations and by withholding federal highway funds.

2–3 PROJECT DESCRIPTION

2–3.1 Proposed Control Measures

Control measures are defined as those methods of PM_{10} abatement that could be placed onto portions of the Owens Lake playa and, when in place, would be effective in reducing the PM_{10} emissions from the surface of the playa. For approximately the last twelve years, the District and other researchers have been involved with the study of the lake environment and the mechanisms that cause Owens Lake's severe dust storms. For approximately the last six years the District has pursued a comprehensive research and testing program to develop PM_{10} control measures that are effective in the unique Owens Lake playa environment. The Attainment SIP proposes that three control measures be used to control PM_{10} emissions: shallow flooding, managed vegetation and gravel. This section describes the control measure development process, the three measures selected for implementation, support infrastructure and the proposed configuration of the control measures and infrastructure.

As was discussed in Section 1-2, "Purpose of this EIR," this document is intended as a first-tier EIR. Accordingly, it is designed to be adequate under CEQA for the District's adoption of the Attainment Demonstration SIP and initial implementation order. The following project description contains many details regarding the type, location and operation of the PM_{10} control measures and support infrastructure. At the same time, it does not in every case describe every project element in final engineering detail. The design of certain project components is not final and final design will need to take place before they are implemented. However, this EIR is designed to be adequate to analyze the significant environmental impacts of the essential project elements if implemented as described. For those elements that are not described in detail sufficient for that element to proceed, additional environmental analysis will be required. These include, but are not limited to, the location, size and layout of the gravel mine and the specific manner in which water is delivered to the water-based control measures.

The description of each control measure (shallow flooding, gravel and managed vegetation) contains a performance standard which the control measure design and implementation must satisfy. For example, in the areas of the lake designated for shallow flooding, the City must distribute water so as to achieve 75 percent coverage with standing water or saturated soil, as determined by aerial photography, during the period from September 15 of each year to June 15 of the next. The District predicts that if the City meets the performance standard for each control measure, the three control measures taken together will abate most of the lake's particulate emissions and attain the federal air quality standards by the attainment deadline imposed by law.

How the City designs and implements each of the control measures so as to satisfy the performance standard, is largely left to the discretion of the City. The District will require for each control measure that certain mandatory elements be incorporated into the City's control measure design. These mandatory elements have been deemed essential either to ensure the air-quality effectiveness of the control measure, or to prevent a significant environmental effect. The mandatory elements are set forth in the Project Description at the end of the description of each control measure.

Except for those mandatory elements, all other aspects of the project description are conceptual only, and are subject to change based on the City's decisions about how to design and implement the control measures so as to achieve the applicable performance standards. The District has included conceptual elements in its project description in order to illustrate how the control measures will probably, or may feasiblely, be designed and implemented, both to achieve the control measures' performance standards, and to avoid or mitigate any significant environmental effects. This conceptual illustration is intended to show that the performance standards may be feasiblely achieved, to predict the probable adverse environmental impacts of the District's air quality control strategy, and to assess the feasibility of avoiding or mitigating those impacts which are determined to be significant. Thus, except for the mandatory elements, the District cannot guarantee that the City's method of designing and implementing the air quality control measures will match the description set forth in the Project Description.

Since this document is a first-tier EIR, it is not designed to be the final word on possible environmental effects of the air quality control strategy. As a public agency, the City is also bound by the procedural and substantive provisions of the California Environmental Quality Act (CEQA) which apply to its discretionary decisions about how to design and implement the control measures. Thus, it is probable that either the City, or other public agencies which must give approvals to permit the control measure implementation to proceed, will conduct further CEQA environmental review of certain major discretionary decisions that are the City's to make, such as: (1) where and how to obtain the gravel for the gravel-based control measure, and how to transport the gravel to the areas on the lake bed designated for gravel; and (2) where to obtain the water to supply the water-based control measures, and how to deliver it to control areas on the lake, and where and how to obtain water to replace that applied to the lake, if it chooses to do so.

As those decisions are within both the particular expertise and discretion of the City, the District cannot predict them with certainty. This EIR has addressed most of those issues conceptually, but the CEQA process of the City (and of other appropriate public agencies) can be expected to address them in project-level detail, and with the opportunities for public review and comment required by CEQA. Moreover, the site-specific mitigation measures, and design and implementation method alternatives, that prove necessary and feasible to avoid causing significant environmental effects, will be assessed in that process. Thus, though the City retains significant discretion in control measure design and implementation, it is nonetheless bound by the CEQA requirement not to adopt design and implementation elements which have significant adverse environmental effects, unless those effects cannot be avoided by feasible mitigation measures, or by feasible alternative approaches.

2–3.1.1 Control Measure Development Selection and Implementation Process

The three control measures selected to control PM_{10} emissions from Owens Lake are common types of measures that are used on fugitive dust sources throughout the country. However, the ultimate PM_{10} mitigation measures implemented on the bed of Owens Lake will be implemented on very large scales. The construction of the final control measures will cover or affect about 35 square miles (22,400 acres) of lake bed.

Due to the size of Owens Lake, the cost of implementing any type of mitigation measure on such a large scale will be considerable. In order to avoid unsuccessful measures, the District developed a control measure development process. This process is a logical, step-by-step approach to generating a final plan in the least amount of time, for the lowest possible cost, with the greatest possible chance of ultimate success. This approach allows for a certain amount of flexibility over time. As more is learned about Owens Lake, its physical processes and which mitigation measures appear to offer the most promise, the plan can be adjusted and modified. However, the framework of the plan must be adhered to in order to maximize the chances that a timely, cost effective and successful plan will be implemented. In February 1992 the District set forth this approach in a document known as the "Long Range Dust Mitigation Program for Owens Dry Lake" (GBUAPCD, 1992).

The District felt that it was of particular importance to involve members of the public and affected government agencies during all parts of the control measure development effort. Therefore, in order to keep all interested and affected parties involved in the process, the District established the Owens Lake Advisory Group that is open to anyone with an interest in the efforts to control the PM_{10} emissions in the OVPA. The Advisory Group was established in February 1991 and meets once or twice a year to solicit ideas, discuss upcoming projects and report on work that has been accomplished. A current list of Advisory Group members is contained in Appendix A. Each year, after public input on project directions is obtained, the District submits a summary of current work, a draft project proposal and a preliminary budget to the LADWP for review. The District and the LADWP then discuss the project direction and the budget details and agree on a funding assessment for the upcoming fiscal year. This process occurs annually to ensure that the LADWP is involved with the District in the development of a control plan by the required deadline. The District has always ensured that the LADWP has had access to and been allowed to participate in all aspects of control measure development and plan preparation.

The control measure development, selection and implementation process can be divided into two main steps. The first step is a thorough understanding of the Owens Lake's physical characteristics and the generation mechanisms of PM_{10} events. This work started approximately twelve years ago and remains an ongoing part of the control effort. The second step of the process is the testing of promising measures. Feasibility studies, small-scale tests and large-scale tests all provide opportunities to evaluate control measures in cost effective increments. The District has invested most of its resources in the feasibility testing phase of the program.

Owens Lake Physical Characteristics and Dust Mechanisms: Before the dust pollution from Owens Lake can be controlled, the Lake itself must be understood. This required an inventory of the lake's diverse and sometimes unique physical characteristics and a more complete understanding of the processes and conditions associated with dust events. In 1991, the District began a comprehensive program of assembling the data compiled to date, identifying additional needs and collecting the required information. The following is a list of the physical properties of Owens Lake and the surrounding area that have been or are being inventoried:

- Meteorology
- Air quality
- Topography
- Geology
- Soil types
- Soil chemistries
- Groundwater characteristics
- Surface water characteristics
- Existing vegetation types and locations
- Existing wetlands types and locations
- Existing wildlife resources
- Actual and potential wildlife habitat

In addition to an understanding of the lake's physical properties, it is important to understand how and where dust storms originate. By studying the connection between the Lake's physical characteristics and meteorological processes, the factors that influence the initiation of dust storms can be understood and thereby controlled. This work involves identifying the mechanisms of dust generation on the lake, including both dusts that are directly airborne, such as salts and fine soil particles, and dusts generated from larger particles via the saltation process. Much of this research has been provided by consultants and advisors to the District such as the California Air Resources Board, the National Oceanic and Atmospheric Administration, the Midwest Research Institute and the University of California, Davis.

To obtain accurate geographic data and use the data collected to make sound decisions, a formal data collection, management and analysis system has been set up. This system uses global positioning systems (GPS) to accurately locate data collected and a geographic information system (GIS) to manage and manipulate the large volume of data that is being compiled and analyzed.

Control Measure Development: The information collected during the study of the lake's physical characteristics is then used to determine the control measure or measures that are most appropriate for implementation in a particular area. Two main criteria are used to identify potential control measures. First and foremost, the measure must show some promise of being effective and feasible. Based on knowledge of the lake's environment, if a potential measure either will not reduce PM_{10} sufficiently to meet the NAAQS or cannot be implemented, the measure will not be pursued.

The second criterion used to evaluate potential control measures is that of compatibility with the existing and former lake environment. As stated above, the lake bed is owned by the State of California and is managed by the SLC. It is the SLC's responsibility to protect the public trust resources associated with the lands under its jurisdiction and control. In letters to the District dated October 1991, August 1993 and September 1994 (Appendix B) the SLC staff informed the District that control measures that did not take into account the public trust values of the lake were unacceptable. Therefore, before a control measure can be tested and ultimately implemented, it must be effective, feasible and consistent with the State's public trust obligations.

The first step in the control measure testing process is to prepare a feasibility study. The study addresses such issues as small- and large-scale testing, expected effectiveness, measure advantages and disadvantages, full implementation, environmental impacts and costs.

For the measures that are identified by the preliminary studies as being feasible and environmentally acceptable, small-scale tests are designed and implemented to test the measures' effectiveness under varying field conditions. The size of these small-scale tests are variable and dependent on the measure tested, but are no larger than necessary to determine whether the measure shows some promise of being effective on a large scale.

The next step in control measure development is to design and implement large-scale tests for those measures that show promise on a small scale and that require large-scale testing in order to determine control effectiveness. The purpose of this final level of testing is not only to test control effectiveness on a large scale, but also to ascertain the costs and obstacles associated with implementing, operating and maintaining a large-scale system. These large-scale tests may provide some level of PM_{10} control.

The final step in the measure development process is to use the results of all the studies and testing to generate a comprehensive implementation plan. The Attainment State Implementation Plan (SIP) and this EIR are the final result of the control measure selection process.

Control Measure Implementation: Upon completion and adoption of the SIP, the District will issue an order or orders directing the City of Los Angeles to undertake implementation of the control measures as set forth in the SIP. In addition to implementing control measures, continued monitoring of control measure effectiveness, and monitoring the implementation of mandatory mitigation measures will be necessary. This will include air quality monitoring, control facility inspection and monitoring of mandatory mitigation measures ordered to safeguard resources such as water, soils, vegetation and wildlife that may be impacted by operation of the control measures.

2–3.1.2 Conceptual Control Measure Water System

The SIP and the subsequent implementation orders will require the City of Los Angeles to supply adequate water to operate the water-based control measures and to deliver that water to the relevant control areas on the lake bed. The SIP and the implementation orders will not direct the City to obtain the water from any specific source or to use any specific system to deliver the water to the lake bed. However, to adequately analyze the environmental effects of the project, the District must forecast a probable water source and delivery system. The District has concluded that use of surface waters currently exported, delivered adjacent to Owens Lake via the Los Angeles Aqueduct, is a feasible and probable source and delivery system for the water that the City must supply to implement the water-based control measures. The EIR analyzes the project's environmental impacts on the basis of this conclusion.

Supplying water for the two water-based measures (shallow flooding and managed vegetation) from the Los Angeles Aqueduct will require the construction of a water transmission and distribution system from the aqueduct to the control measure areas on the lake bed. As with the source of the water for PM_{10} control, the SIP and implementation orders will not dictate the actual route for the water supply pipeline. However, to adequately analyze the environmental effects of the project, the District must forecast a probable route for the water supply and will determine the feasibility of transporting water from the LA Aqueduct to the Owens Lake bed.

The aqueduct is located approximately 180 feet above the historic shoreline, so that all water can be delivered by gravity. As phasing of the control measures is proposed to generally proceed from north to south, the water supply route will likely come from the north. It is likely that project water would be supplied from the aqueduct in the vicinity from north of Carroll Creek to south of Diaz Lake (aqueduct elevation approx. 3,780 ft). At this location, the aqueduct varies from about ½ to 3½ miles from the edge of the lake bed. See Figure 2.4 for a topographic map showing one possible pipeline route zone. A number of potential routes exist in this area that cross lands owned by the City of Los Angeles, Bureau of Land Management and/or private parties. There are also significant sections of historic shoreline in this area that are devoid of wetland-type vegetation and lake bed spring activity.

Construction of a turn-out diversion structure at the aqueduct is projected that would allow the controlled diversion of flows into a buried pipeline. The improvements at this point would consist of concrete modifications to the aqueduct, a regulating and emergency shut-off valve system, and a concrete valve vault structure. Water would be diverted from the aqueduct into a buried transmission line, approximately 48 to 60 inches in diameter, and would be conveyed by gravity toward the lower end of the Owens River delta (elevation approximately 3,565 ft), where it would enter the transmission and distribution system. The static system pressure at this point would be approximately 90 pounds per square inch (psi).

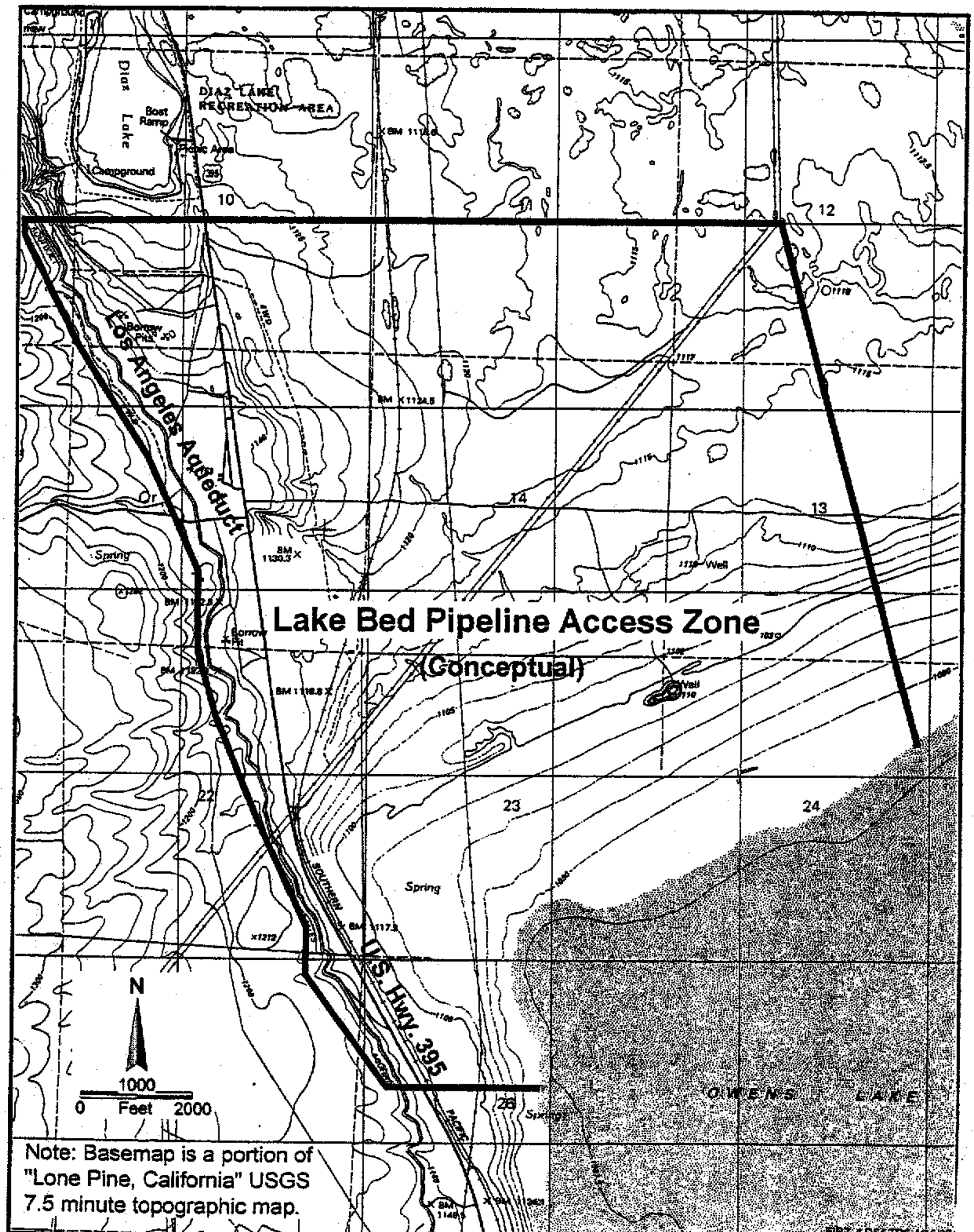


Figure 2.4: Topographic map of lake bed pipeline access zone (conceptual).

The water transmission and distribution system is projected to include the installation of pipelines and valves of various sizes, ranging from 12 to 48 inches in diameter, in a network conceptually illustrated in Figure 2.5. The water distribution network can be engineered to provide for peak flows and distribution flexibility. Depending on pipe size and pipe location, pipe materials may include: high-density polyethylene (HDPE), polyvinyl chloride (PVC), cement-lined steel, cast iron or ductile iron. All pipe will be buried in trenches two times as wide as the diameter of the pipe and one to two times as deep as the diameter of the pipe. Pipeline routes on the lake bed should be located to avoid delineated wetlands, except in the area where the transmission main from the aqueduct crosses the lower Owens River delta (Figure 2.3). Due to the potential for earthquakes in the Owens Lake area, the water transmission system is projected to include automatic "loss of pressure" emergency shut-off valves located at critical points in the system. These hydraulically operated valves automatically shut off transmission main flows in case an earthquake causes pipes to rupture.

The water delivery system for areas controlled by shallow flooding is projected to include buried valved sub-mains off the main transmission line spaced approximately every 2,500 feet and running parallel to the transmission main. Water would be released from the 12-inch sub-mains via outlets to the surface at points spaced 50-200 feet apart. To minimize the creation of potential mosquito breeding habitat, the outlets will be designed with erosion-resistant energy dissipaters to prevent soil erosion and the creation of outlet pools. To increase water use efficiency, it is a mandatory design element of this control measure that excess water that flows to the lower edge of shallow flood areas be collected and pumped back up to the outlets for reuse.

The water delivery system for areas controlled by managed vegetation is projected to consist of an open system of regulating reservoirs, water delivery laterals, and drainage ditches. The regulating reservoir will also function as a primary water delivery channel extending from the northern to the southern boundary of the control area near the playa margin. Water will be released from this reservoir through valved and metered eighteen-inch pipes into distribution laterals that will convey it to the vegetated fields. End-gated eighteen-inch pipes will release water from the laterals to the irrigated fields. A system of open ditches will collect drain water from the fields which will be either discharged to saturated evaporite deposit sump areas or re-circulated into the irrigation system, depending upon its quality.

Except for one pipeline crossing of the lower Owens River delta and a few minor crossings of spring mound areas, pipeline routes and open water delivery channels on the lake bed should be located to avoid delineated wetlands. The managed vegetation control measure will outlet water from the transmission main to a system of open regulating reservoirs, channels and ditches to deliver, drain and re-circulate the water. It is projected that all pipeline will be buried.

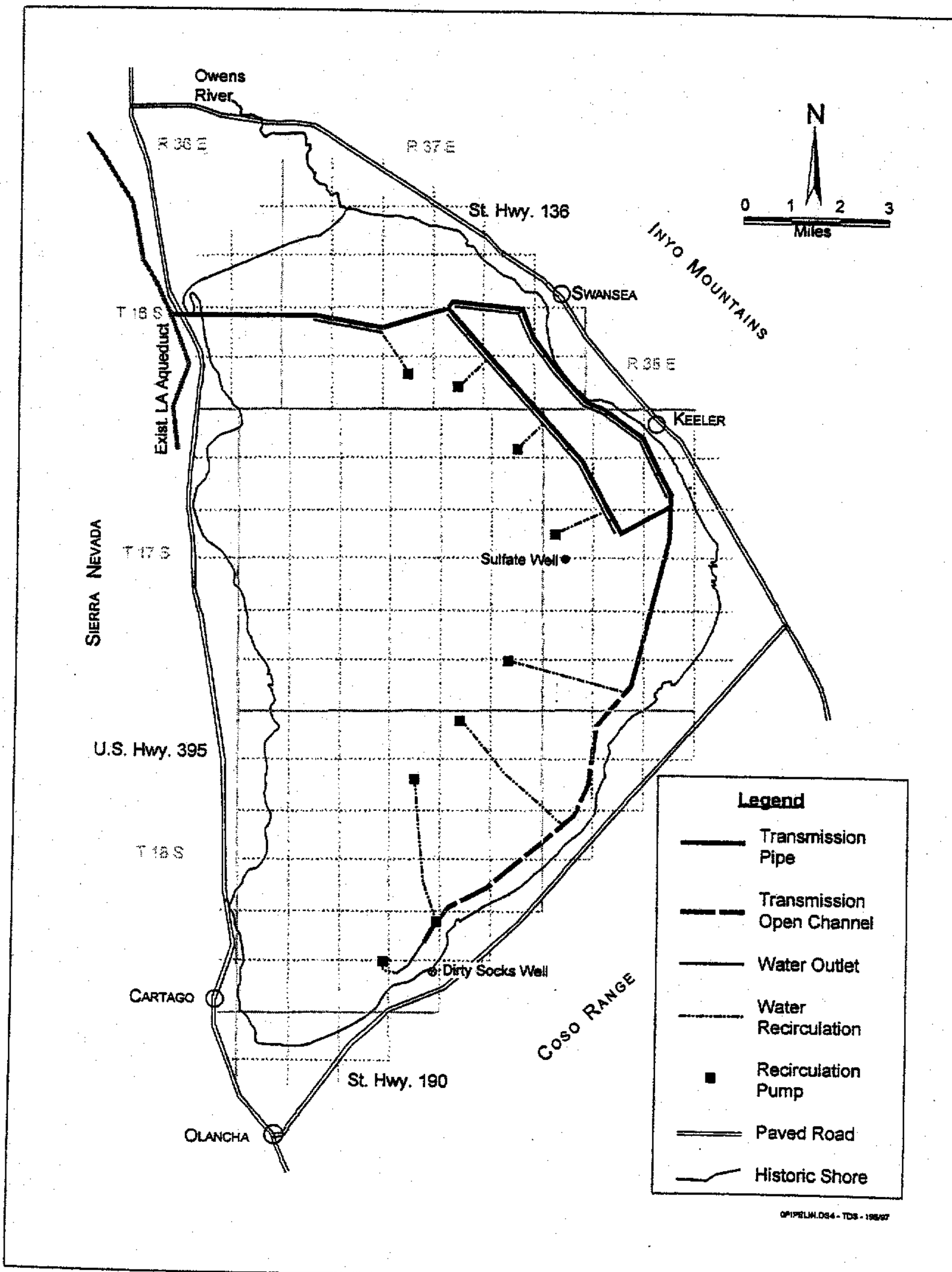


Figure 2.5: Conceptual pipeline network.

Operation and maintenance activities associated with the water transmission and distribution system consist of routing water from the Aqueduct to the areas where water is required. This will require the operation of valves, pipeline inspections and monitoring of flows. For the earthen water transmission structures, operation and maintenance requirements will include periodic repair and cleaning of the structures. Staffing requirements are estimated at approximately one full-time equivalent employee (FTEE) per 50 miles of buried pipeline and two FTEE per 50 miles of earthen transmission structures (GBUAPCD, 1997b).

2–3.1.3 Conceptual Control Measure Support Infrastructure

Figure 2.6 is a conceptual diagram of the other proposed infrastructure elements: electrical power lines, roads, berms and flood drains. Electrical power will be required to operate pumps that will recirculate waters collected at the lower end of the control measure areas. The power will be provided by the LADWP from existing power lines along State Highways 136 and 190, and brought to each pump site via new overhead lines that will be constructed parallel and adjacent to berms and access roads. Installation of the power line will require digging holes for poles and stringing the lines. Some portable pumping equipment will be operated with either portable diesel generators or will be directly driven with maintenance equipment power take outs (PTOs).

To protect snowy plovers from birds of prey, above-ground power lines should be placed at least ½ mile from snowy plover nesting sites known at the time of construction. Any power lines that need to serve facilities within ½ mile of known snowy plover nesting sites shall be buried.

Permanent improved roads will be constructed for access to the control measure areas. Roads will also be constructed parallel and adjacent to the buried water distribution lines and on earthen primary and lateral water distribution channel sides in the managed vegetation area. All permanent improved road beds will have a ten-foot wide driving surface and will be raised at least two feet above the lake bed. Drainage culverts or "Arizona-type" at-grade crossings will be installed to allow control measure waters and flood waters to pass under or over roads.

Road beds will typically be constructed by pushing up lake bed soils from about 50 feet on one side of road centerlines to create a mounded linear strip. The mounded soil will be compacted and capped with a ten-foot-wide driving surface of imported aggregate base or asphaltic cement. Berm side slopes will be a maximum of 3:1 (horizontal to vertical) with short 5:1 sections approximately five feet wide spaced every 500 feet to provide for snowy plover chick crossings. Temporary roads, associated with pipelines and other infrastructure or control measures, may be constructed but would follow the alignment of the permanent roads.

Roads associated with earthen water distribution structures will be located on the top of the berms that form the structures. Access to fields within the vegetated areas will be via smaller, narrower roads designed for farm-type vehicle traffic only, and will be of a secondary nature. Security gates will be placed at all locations where new gravel roads intersect existing roads on the lake bed to deter unauthorized individuals from gaining access to areas of the lake bed that are currently inaccessible to vehicular traffic due to the absence of roads.

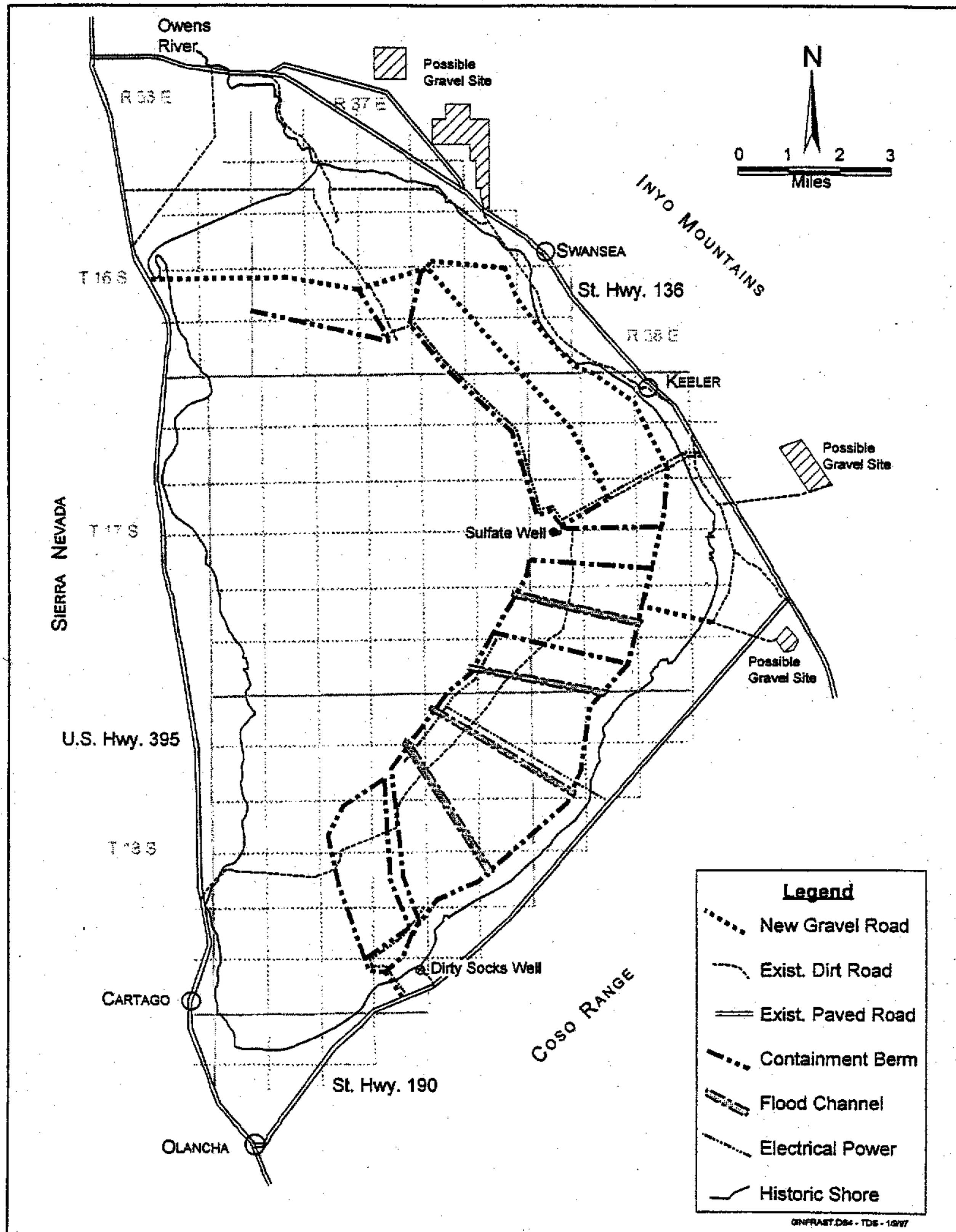


Figure 2.6: Conceptual infrastructure network

To protect flightless snowy plover hatchlings during the nesting and fledgling season that extends from March 1 to July 31, during this period speed limits on the lake bed will be fifteen miles per hour (15 mph) within 1,000 feet of known or expected plover nesting areas. In addition, warning signs will be posted on all lake bed roads to alert drivers to the possibility of plovers in the roadway.

To isolate control measure areas from each other, protect control measures from being flooded and prevent project water from flowing uncontrolled into the brine pool, earth berming will be used. The berms will be constructed on the uphill boundary of vegetation and gravel areas, on the downhill boundary of all control measures and at the lateral boundary between control measure areas. Berms on the lower edge of managed vegetation and gravel areas should be designed and constructed to prevent flooding from high brine pool levels such as the levels seen in 1969 when the brine pool rose to 3,560 feet. This will require berms from two to twelve feet high. Berms will be constructed by pushing up lake bed soils. They will have a ten-foot top width and an eight-foot wide improved road will be centered on the top (imported aggregate base or asphaltic cement). Berm side slopes will be a maximum of 3:1 with short 5:1 sections approximately five feet wide spaced every 500 feet in order to provide for snowy plover chick crossings. In some cases, where berms may be subject to continual inundation or potential high water velocities, berm faces will be protected from erosion with rock rip-rap or gunite coverings. Where soil conditions, groundwater conditions or surface water conditions require, berms will be keyed into existing lake bed soils.

Berms may also be used to protect cultural resources that are determined to be significant. If permitting agencies determine that cultural resources found within the project area are significant, it is possible to isolate these sites from control measure elements by simply avoiding the sites and surrounding them with berms to prevent flooding from water-based measures. The decision to recover cultural resources or to avoid and protect with berming would be made on a case-by-case basis.

It is a mandatory requirement of the Project that vegetation area infrastructure and gravel areas be protected from the infrequent, but sometimes intense, flood waters that originate in the Inyo and Coso Mountains and flow onto the lake bed. This objective may be achieved by construction of flood control drains. These drains would divert flood waters across the control measure areas and outlet them into the existing brine pool or into reservoirs used to store water used for managed vegetation. The drains should be designed to accommodate alluvial depositions. This may include such design elements as desiltation/retention basins or channel design to maintain material transport velocities. For the purposes of this analysis, it is assumed that the drains would consist of wide shallow channels bordered on both sides by earthen berms. Channel berms would be constructed by pushing up the material excavated from the channel bottom. One of the berms would have an access road constructed along the top. Because the largest expected flood in an area depends on the watershed area, the expected rainfall and the desired level of protection, the actual location, size and construction details of these structures will be individually designed. As with other elevated lake bed structures, provisions shall be made for snowy plover chick crossings.

The potential for liquefaction of soils due to seismic ground shaking on Owens Lake is high (Section 3–1.3.2.1). With the exception of large berms, however, the potential for damage of proposed water facilities, support infrastructure and control measure components is low.

Nevertheless, all improvements and infrastructure will be designed to withstand liquefaction impacts to the extent that is economically feasible.

Maintenance activities associated with support infrastructure will include normal electric utility line maintenance and meter reading and maintenance of the road, berm and drainage systems. Staffing requirements are estimated at one FTEE per 50 miles of power line, roadway, berm and flood channel (GBUAPCD, 1997b). All regularly assigned operations and maintenance staff will be instructed in the identification of western snowy plovers and their habitat, the sensitivity of western snowy plovers to human disturbance, and measures that must be adhered to so as to reduce potential impacts to the species (such as obeying posted 15 mph speed limits). All operations and maintenance staff will be instructed in the importance of locking gates to deter unauthorized entry.

2–3.1.4 Shallow Flooding PM_{10} Control Measure

The surfaces of naturally wet areas on the lake bed (i.e., those areas typically associated with seeps and springs) are resistant to wind erosion that causes dust. Shallow flooding mimics the physical and chemical processes that occur at and around natural springs and wetlands (Figure 2.7). In these areas, water discharges across the flat lake bed surface by raising the level of the shallow groundwater table to the surface. The areal extent of wetting is dependent upon the amount of water discharged to the surface, evaporation rate and lake bed topography. The size of the wetted area is less dependent on soil type because, once the water table is raised to the playa surface, surface evaporation is soil-type independent. Shallow flooding provides dust control over large areas with minimal infrastructure and it requires minimal ongoing operation, maintenance and lake bed access.

This control measure consists of releasing water along the upper edge of the PM_{10} emissive area elevation contour lines and allowing it to spread and flow down-gradient toward the center of the lake. To attain the required PM_{10} control efficiency, at least 75 percent of each square mile of the control area must be wetted (i.e., standing water or surface saturated soil) between September 15 and June 15 each year. This coverage can be determined by aerial photography (Hardebeck, 1996). To maximize project water use efficiency, flows to the control area will be regulated at the outlets so that only sufficient water is released to keep the soil wet. Although the quantity of excess water will be minimized through system operation, any water that does reach the lower end of the control area will be collected and recirculated through the system. At the lower end of the flood area, or at intermediate locations along lower elevation contours, excess water will be collected along collection berms keyed into lake bed sediments and pumped back up to the outlets to be reused (Figure 2.8).

Due to the generally flat, uniform nature of the lake bed, the outlet water would spread over wide areas to create a random pattern of shallow pools. These pools would be generally less than a few inches deep. Pooled areas will produce no PM_{10}, and will act as sand traps to prevent crust abrasion and dust generation. Damp and saturated soils also resist wind erosion. Locally high areas or "islands" of non-wetted soil tend to self-level; the soil blows off the higher islands and is captured in the pools. Thus, over time the high areas would become lower and the low areas would become higher. This leveling process can be expected to occur over a period of a few years. In some limited cases, it may be necessary to mechanically level high areas. This would occur primarily where

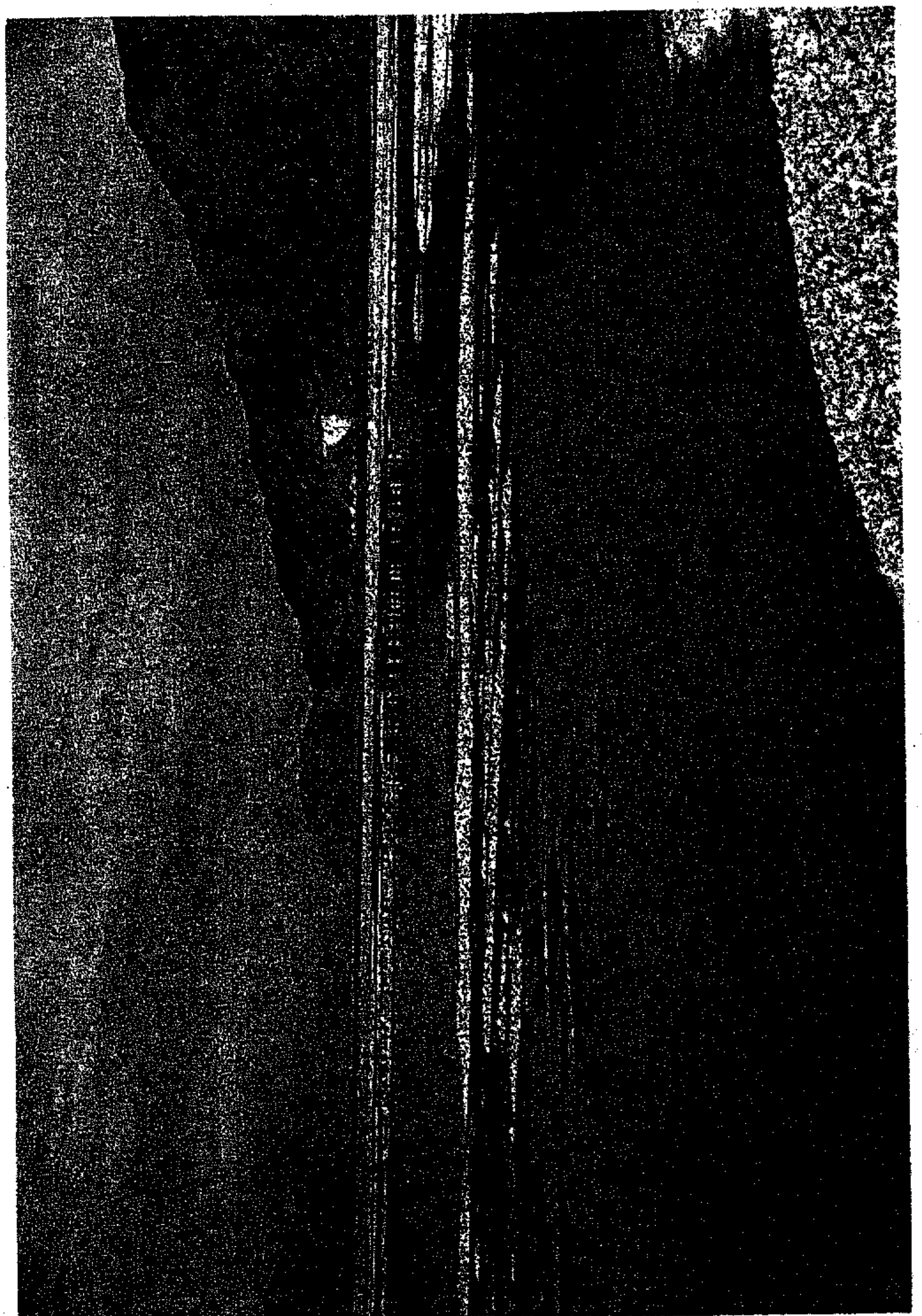


Figure 2.7: Shallow flooding - test site photograph.

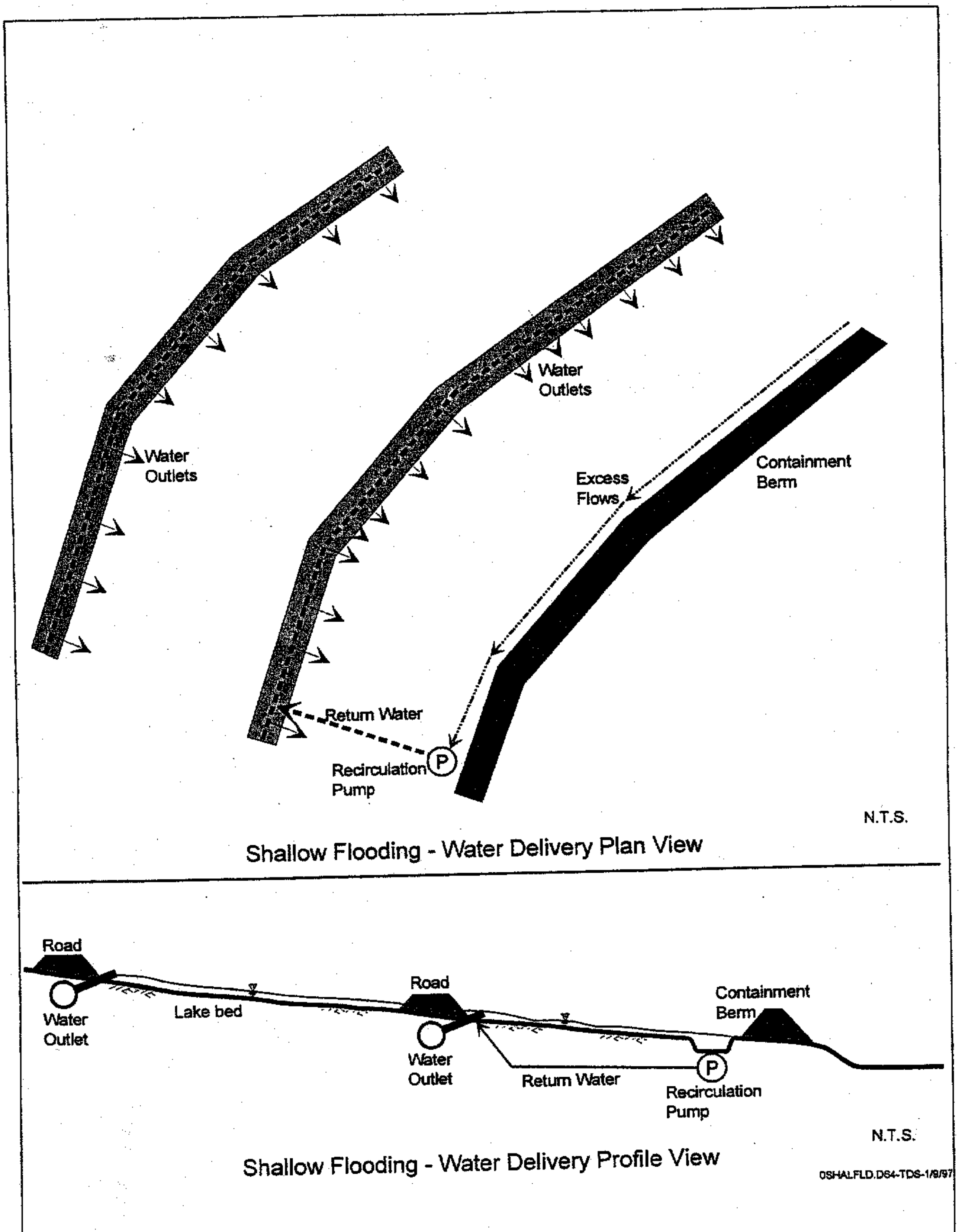


Figure 2.8: Shallow flooding - conceptual water delivery schematic.

previous earthwork performed on the lake bed prevents natural uniform spreading of PM_{10} control waters.

Prior to testing shallow flooding on a large scale on Owens Lake, there was concern that the addition of water over large areas sufficient to raise the shallow groundwater table to the surface would create new areas of salt efflorescence. The results of the large-scale tests indicated that salt efflorescence caused by shallow flooding was insignificant, between 0-1 percent of the test area (Hardebeck, 1996).

Shallow Flooding Habitat: Where shallow flood water is distributed across the playa, opportunistic plant species are expected to establish themselves where conditions are favorable. Limited stands of cattails (*Typha* sp.), sedges (*Carex* sp.), saltgrass (*Distichlis spicata*), and other species associated with saturated alkaline meadows of the region have colonized the immediate vicinity of the water outlets on the flood irrigation project. Based on testing performed by the District at the North Flood Irrigation Project test area, naturally established vegetation can be expected to immediately occur on about ½ percent of the area that is controlled with shallow flooding (GBUAPCD, 1994). This percentage may increase over time.

The expansive shallow flooded areas and the naturally established vegetation provide ephemeral resting and foraging habitat for wildlife use. Figure 2.7 is a photo of the District's North Flood Irrigation Project during a shallow flooding testing project. A large flock of shorebirds can be seen using the wetted area. Figure 2.9 is a photo of cattail vegetation that naturally established near the water outlets on the shallow flooding test site. Insect and shorebird utilization of wet areas created by District testing on the lake bed was common during control measure testing. Based on these previous experiences, it is anticipated that shallow flooding will create large areas of plant and wildlife habitat in areas where very little previously existed. Due to the initially hostile environment for plants on Owens Lake and the desire to vegetate as much of the lake bed as possible in order to provide for effective PM_{10} control, livestock grazing will be prohibited in areas where shallow flooding will be used as a PM_{10} control measure.

In addition to desirable plant species, such as those listed above, that may invade and help to control PM_{10} emissions, there is the possibility that undesirable non-native salt cedar (*Tamarix ramosissima*) may invade wet playa areas. A mandatory element of this project will be a program to remove any salt cedar that invades PM_{10} control areas. Salt cedar on the lake bed will be controlled independently or through annexation into Inyo County's control program. Annexation into the County's program would require a cooperative agreement with Inyo County.

Every effort will be made to limit the potential for introduction of exotic pest plant species into source emission areas that will be controlled through the use of shallow flooding. Fortunately, the existing saline soil conditions inherent to the lake bed are inhospitable to most plants including exotic pest plants such as tamarisk, puncture weed and Russian thistle and noxious grasses such as Cenchrus. Exotic pest plants and noxious grasses will be removed from the source emission area (if present) prior to the initiation of shallow flooding. Removal will be accomplished through an appropriate combination of biological, mechanical and chemical control methods.

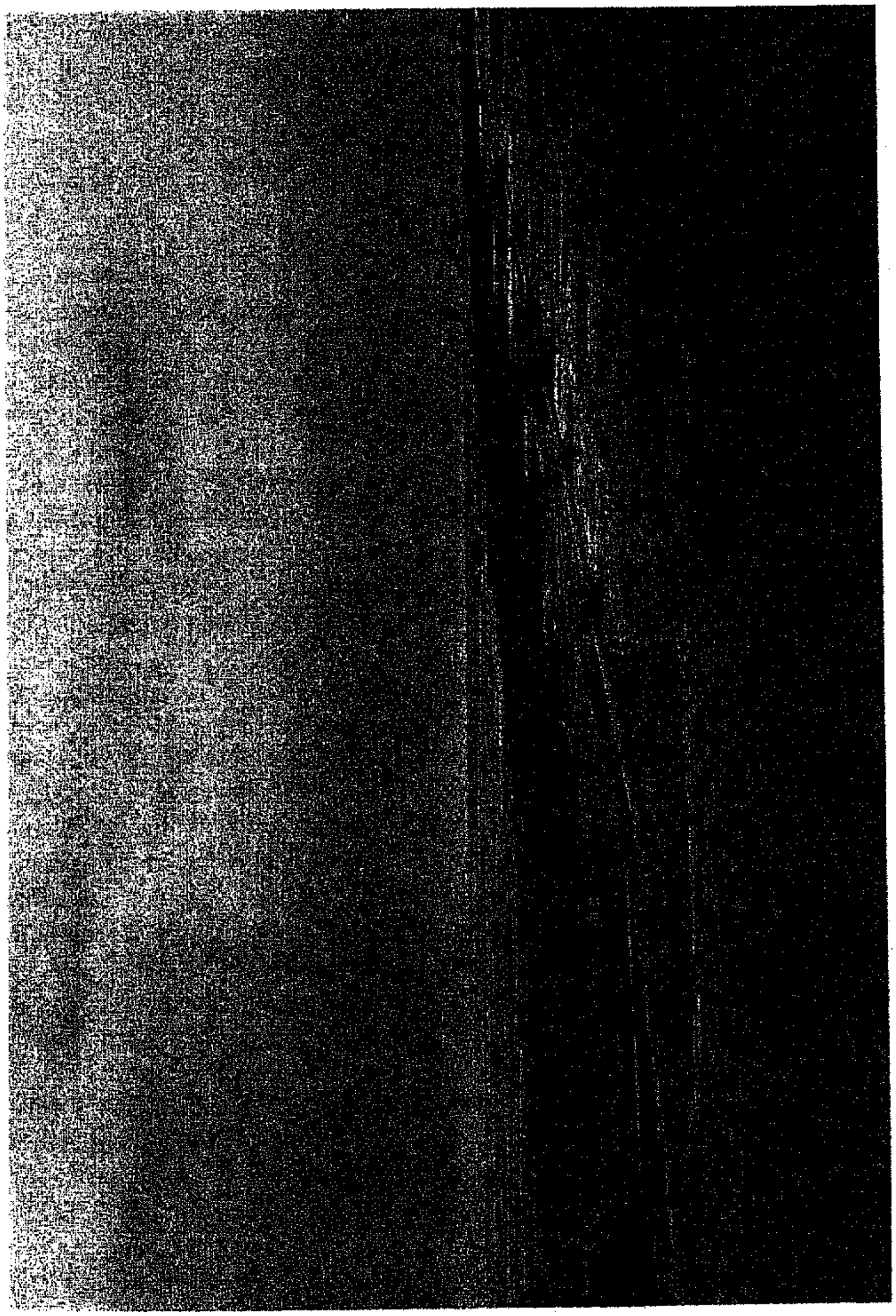


Figure 2.9: Shallow flooding - photograph of naturally established vegetation.

A key consideration in the design of the Shallow Flooding PM_{10} Control Measure for Owens Lake has been the need to maintain existing breeding population of shorebirds, and the western snowy plover in particular. Owens Lake is an important stopover on the Pacific flyway. Thousands of shorebirds stop at Owens Lake in the spring. The majority of these shorebirds continue northward to breeding areas at Mono Lake, northern California, the Pacific Northwest and Canada. Implementation of the Shallow Flooding PM_{10} Control Measure would be expected to provide suitable nesting and foraging habitat until June 15. A portion of the shorebirds that would have normally continued their migration to northern breeding areas are expected to remain at Owens Lake and utilize nesting and foraging habitat created as a result of the Shallow Flooding PM_{10} Control Measure.

Cessation of the Shallow Flooding PM_{10} Control Measure on June 15, prior to successful fledging of shorebirds is predicted to have a significant adverse impact on these shorebird populations. In order to minimize the potential disruption of breeding activities, the water distribution system (Figure 2.10) has been designed with laterals spaced at one mile intervals. Water delivery may be reduced on June 15 but, if reduced, must be continued at a reduced rate from June 16 until July 31 when most shorebirds have successfully fledged. This design ensures that wetted areas, which provide important resting and foraging habitat, are available within a maximum of one-half mile of dry areas on the playa most likely to be support nesting shorebirds. It is anticipated that the reduced water delivery rate during the summer would use approximately 10-20 percent of the water used by the shallow flooding control measure during the September to June period (approximately 1500-2000 gpm during full-flow periods and 150-400 gpm during habitat maintenance flows).

As water conservation is an objective of the City, the shallow flooding control measure is expected to use the minimum amount of water necessary to cover the surface of the lake bed so as to minimize excess run-off and collection. Any water that develops as excess run-off when the control measure is initiated should be collected in a recirculation system. However, because water entering the recirculation system would be excess water, a corresponding adjustment in the output of water onto the lake bed would be made immediately so as to minimize the amount of water required by this control measure. As a result of this effort to minimize the amount of excess water that collects and is recirculated, the water that would exist in the shallow flooded areas would contain a minimal amount of recirculated water. As indicated on page 5-12 of the DEIR, the results of salt crust analysis indicate that metals currently on the lake bed are not present at toxic levels. Therefore, the application of water to the lake bed, and the subsequent potential for leaching of constituents within the lake bed soils, is not expected to result in the formation of water or soils within the shallow flooded areas that would exceed Total Threshold Limit Concentration (TTLC) levels and subsequently be deemed hazardous to wildlife and humans. The District therefore concludes that the recirculation of water in the shallow flooding control measure will have no significant adverse effects on wildlife resources.

Field investigations were performed by mosquito entomologists from the University of California, Davis at District shallow flooding test sites and at natural pond, spring and seep areas around Owens Lake to determine the potential for water-based control measures to create mosquito-breeding habitat (Eldridge, 1995). These investigations concluded that mosquito habitat had limited potential to occur

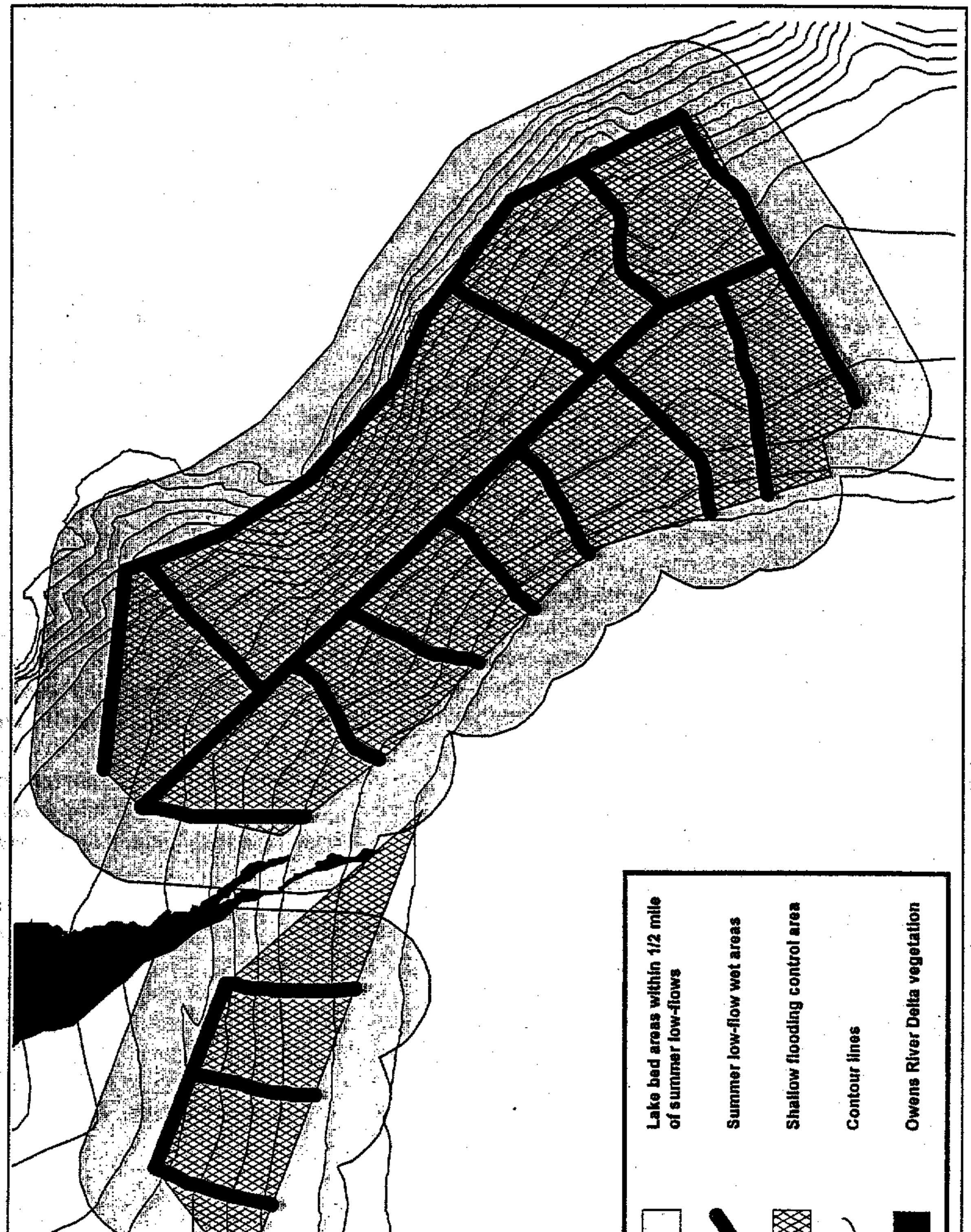


Figure 2.10: Conceptual location of June 15 to July 31 habitat maintenance flows

on the lake bed, but could occur when water depths range from 2-20 inches and when water had essentially no movement.

To prevent the creation of potential mosquito-breeding habitat, a mandatory element of this project will be detailed design of the site infrastructure which incorporate specific measures to minimize water depths ranging from 2-20 inches and to prevent still-water areas from forming. An additional mandatory element of this project will be a program to abate mosquito breeding and swarming. Abatement activities may include application of pesticide or biological controls. These measures are successfully used throughout the Owens Valley. As an alternative to a separate mosquito abatement program, the City of Los Angeles may petition the County of Inyo to annex all water-based control measure areas into the Inyo County Mosquito Abatement Program. Appropriate assessments will be levied to ensure that abatement activities can take place, if necessary.

In recognition of the location of the source emission control areas in an area that is a stopover location for shorebirds and waterfowl, the mosquito abatement program shall be designed to minimize the potential impacts on the breeding success of western snowy plovers and other birds that use the playa. The program will be designed in accordance with the following parameters:

- Preference will be based on biological control measures;
- Mosquitofish will not be introduced into existing aquatic habitats or areas that are connected to existing aquatic habitats;
- Bat house/roosting structures (designed to preclude raptor perching) will be used as a component of the mosquito abatement program;
- Pesticides that have been identified by the State or Federal Environmental Protection Agencies as being known or expected to cause thinning of eggshells in native avian populations will not be used as part of the mosquito abatement program;
- Representative fragments of failed eggs from native birds in mosquito abatement areas recovered during the course of normal mosquito abatement activities will be subject to analysis by a certified laboratory to assess the influence of mosquito abatement activities on egg failure;
- Mosquito abatement activities will be conducted in accordance with State-of-the-Practice procedures established by the United States Department of Agriculture, Animal Damage Control;
- All pest control measures will comply with recommendations of the March 1993 U.S. Fish and Wildlife Biological Opinion related to *Effects of 16 Vertebrate Control Agents on Threatened and Endangered Species* (USFWS, 1993); and
- All pest control measures will comply with recommendations of the *Animal Damage Control Program Final Environmental Impact Statement* (USDA APHIS, 1994).

Shallow Flooding Construction Activities: Shallow flooding will require a water transmission, distribution and outlet infrastructure as discussed above in Section 2–3.1.2. It will also require the construction of electrical power lines, access roads and water control berms as discussed in Section 2–3.1.3.

The large shallow flooding area between Swansea and Keeler (Section 2–3.2.1) could have two outlet lines constructed parallel to lake bed elevation contours and approximately one mile apart. The two outlet lines would allow for improving water use efficiency by allowing more precise control of the location and quantity of water delivery. The other two shallow flooding areas will have only one outlet line along the upper edge of their respective areas. Minor lake bed leveling and earthwork will take place prior to the start of flooding to remove existing obstructions to uniform water spreading and maximize the areal distribution of water.

Construction phasing for shallow flooding will be as follows: temporary construction roads (if necessary), pipeline construction, berm construction, permanent road construction, power line construction and lake bed leveling (if necessary).

Shallow Flooding Operation and Maintenance Activities: Water flows between September 15 and June 15 will be maintained to provide the required 75 percent of the area in standing water or saturated soil. During cool weather when evaporation rates are low, it may be possible to shut off flows completely for short periods as long as saturated soil conditions are maintained. To maximize water use efficiency, water flows should be minimized during the summer months when PM_{10} standard violations are infrequent and evaporation rates are high. It is a mandatory element of this project that minimal water flows be maintained between June 15 and July 31 to sustain established vegetation and wildlife. Between July 31 and September 15 the flows may be shut off completely. Based on the District's large-scale tests of shallow flooding, operating the shallowing flooding control measure in this manner is predicted to use approximately four acre-feet per year (ac-ft/yr) of water per acre controlled. Careful management of shallow flood areas may allow for even less water to be used.

Maintenance activities associated with shallow flooding would consist of minor grading and berming on the control areas to ensure uniform water coverage and prevent water channeling. Staffing requirements for operation and maintenance of the shallow flooding areas are estimated at approximately one FTEE per 3,200 acres of flooded area.

2–3.1.5 Mandatory Elements of the Shallow Flooding Control Measure

The shallow flooding control measure design will apply water to the surface of the areas of the lake bed designated for control by shallow flooding (Areas A, B, and F on Figure 2.19), in amounts and by means sufficient to achieve the following performance standard commencing on September 15 of each year, and ending on June 15 of the next year: 75% percent of each square mile of each of Areas A, B and F shall continuously consist of standing water or surface saturated soil. Coverage shall be confirmed by aerial photography or other methods satisfactory to the District.

Between June 15 and July 31 of each calendar year, the City will supply within the boundaries of the Areas A, B, and F water in amounts and locations adequate to maintain sources of food and water suitable for sustaining nesting and fledgling shorebirds, including western snowy plovers, nesting within the boundaries of those control areas or within ½ mile of their boundaries. If the control measure as implemented creates vegetation of the type and density used as wildlife habitat, the City shall supply water in amounts sufficient to maintain that vegetation in a state suitable for wildlife habitat during the period between June 15 and July 31 of each calendar year.

The City shall construct a berm keyed into the lake bed sediments along the lower boundary of each of Areas A, B and F to minimize the transmission of excess water from the control areas toward the Owens Lake brine pool. The design and implementation of this berm will incorporate snowy plover crossings located at each 500 feet along the length of the berm, adequate in design to freely allow traverse of the berm by both snowy plover adults and chicks. Surface waters that reach the lower boundary of those control areas will be collected and recirculated for reapplication to the control areas. The control measure areas will have lateral boundary edge berms as necessary to contain waters in the control areas and to isolate the control measure areas from each other and from areas not controlled.

The City shall remove any exotic pest plants, including salt cedar (Tamarix ramosissima), that invade any of Areas A, B, and F. As necessary to protect human health, the City shall avoid or abate mosquito breeding and swarming in those control areas by effective means which minimize adverse effects upon adjacent wildlife.

2–3.1.6 Managed Vegetation PM_{10} Control Measure

Where water appears on the playa surface with quantity and quality sufficient to leach the salty playa surface and sustain plant growth, vegetation has naturally become established. The saltgrass meadows around the playa margins and the scattered spring mounds found on the playa are examples of such areas. Vegetated surfaces are resistant to soil movement and thus provide protection from PM_{10} emissions. The managed vegetation strategy creates a mosaic of irrigated fields provided with subsurface drainage to create soil conditions suitable for plant growth using a minimum of applied water. An aerial view of a 40-acre test plot using this strategy is shown in Figure 2.11. Because this measure relies on earthen infrastructure for water distribution, it is best suited for use in clay soils that can be used for the construction of ditches, berms, channels and reservoirs that allow for level border irrigation strategies that leach and drain readily through the fractured structure of the soil. The proposed methods of soil reclamation are similar to those used elsewhere in this country and world-wide for desalinization of salt-affected soils, allowing such soils to be useful for plant growth.

This control measure consists of a creating a farm-like environment containing small (approximately 4-20 acre) confined fields constructed on contour that are irrigated with shallow pulses of water. The amount of water required to leach the soils to within a level suitable for salt-tolerant species depends on specifics of soil type and of surface treatment. Studies at the test plot indicate that between 3½ and 6 feet of water will be necessary to reclaim a two-foot deep soil profile to a level suitable for planting with saltgrass (Ayars, 1997). This amount of water can be delivered to the fields in 4-6 irrigation events, which can take place during a period of about 3-4 months. As the salt levels in the leached plots decline, plants can be introduced to the fields and irrigated using the same methods. Therefore, if leaching began during the winter months, saltgrass could be planted during the spring of the same year.

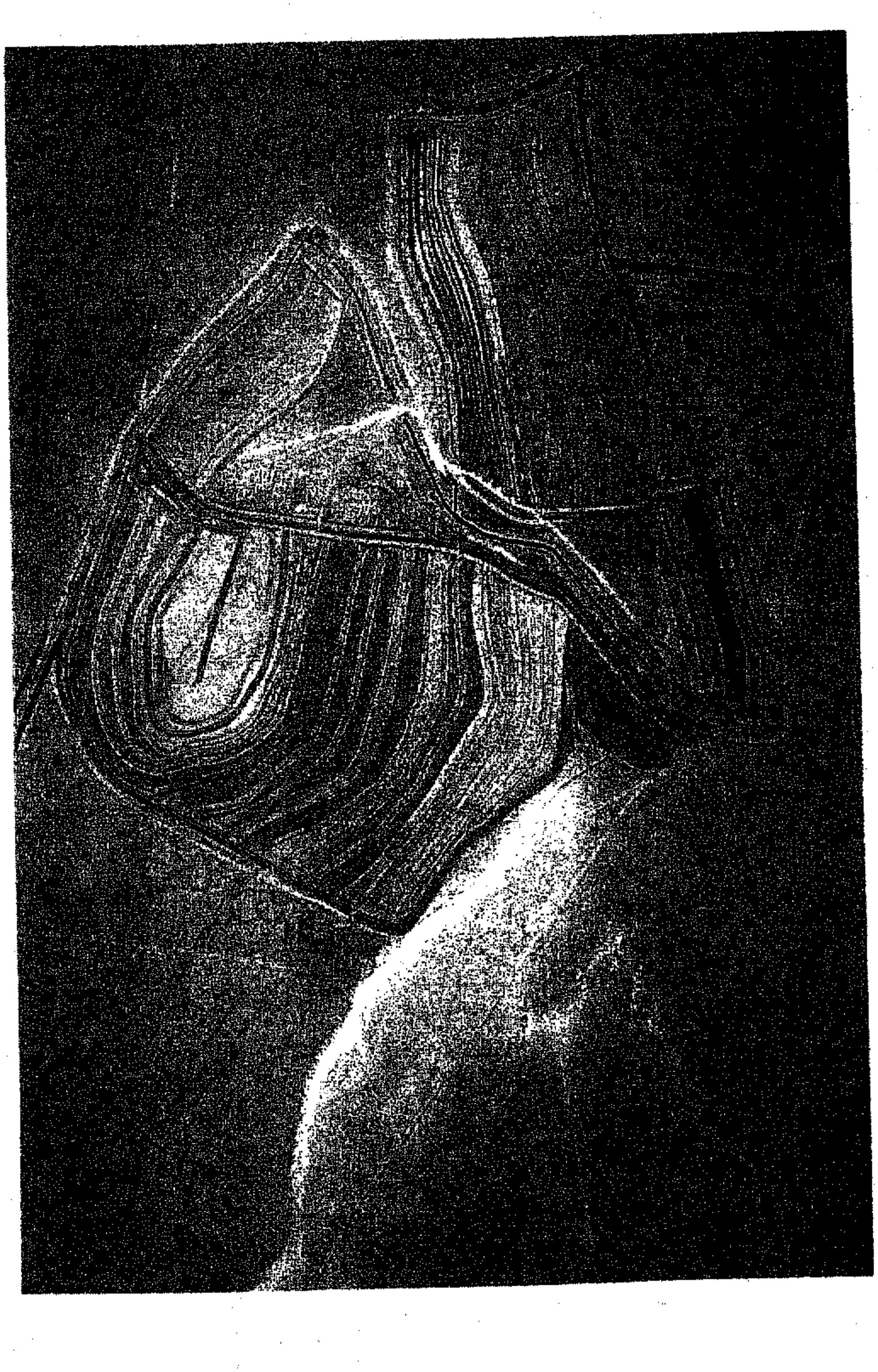


Figure 2.11: Managed vegetation - test site aerial photograph.

To attain the required PM_{10} control efficiency, a cover of at least 50 percent live or dead vegetation is necessary. Data from test plots on the lake indicate that such cover can be achieved during the third growing season. Total cover will include both live and dead plant material, as both function equally well to prevent PM_{10} emissions. Field studies on Owens Lake test plots confirm that the target saltgrass cover of 50 percent can be sustained with two ac-ft/yr of irrigation water. Percent cover can be measured by the point frame method (Scheidlinger, 1996).

Irrigation leaches the soils of the salts, which are removed from the area using subsurface open drains. Leaching with fresh water has the potential to lead to soil dispersion, which can reduce the infiltration capacity of the soil. Field studies have shown that to date, soil dispersion has not been a problem on the fields of the test plot on the Owens Lake playa. The drainage system is constructed, however, to allow for the mixing of fresh water and saline drain water to achieve an ideal irrigation salinity (calculated to be approximately 15 dS/m) (Ayars, 1997). If drain water is not reused for irrigation, the drain water will be discharged to downhill evaporation ponds where a saturated evaporite deposit will be formed and managed in wet condition in order to prevent PM_{10} emissions.

Leaching and irrigation water applied to the managed vegetation will be needed to maintain a downward gradient of salts in the rooting column of the soil of the plots in order to prevent salt from the shallow water table from rising into the rooting zone by capillary action. The drain system in the managed vegetation area will prevent the rise of the water table into the rooting zone on the fields, and the irrigation schedule will maintain the necessary downward gradient within the rooting zone.

Constructing the fields on contour means that the fields are essentially flat, and the water spreads evenly over them allowing for very efficient irrigation. The leaching fraction of the irrigation water will be recovered in the drains. During the initial years of the project, this drain water will contain sufficient salts to render it useless as irrigation water, and it will be discharged for use in shallow flooding or to the low sump locations. As the fields improve in quality, the drain water may be of a quality adequate for recirculation as irrigation water and can be returned to the fields.

The sump area saturated evaporite deposits will be located adjacent to the existing evaporite deposit above the brine pool. The deposit areas will be constructed in clay soils. Intrusion into the existing deep groundwater system will be prevented by the high upward hydraulic gradient experienced in this area (approximately 40 feet above the surface in the nearby existing South FIP well). As with many areas of the lake bed, these upward groundwater gradients maintain high soil moisture levels and will help to maintain the deposits in a wet condition. Management of contoured field drainage waters will ensure that the deposits remain wet and non-emissive. As the soils in the contoured fields are leached of salt, their drain water will be able to be recirculated back into the irrigation system.

Saltgrass (*Distichlis spicata)* will be the only plant species considered by this EIR to be introduced to the fields. It is tolerant of relatively high soil salinity, spreads rapidly via rhizomes, and provides good protective cover year-round even when dead or dormant (GBUAPCD, 1996a). Saltgrass stands can subsist with minimal amounts of applied water during the summer, and dust control effectiveness remains undiminished, provided that adequate irrigation has stimulated plant growth and has provided stored water in the plants' rooting zone during the spring months (GBUAPCD, 1996b).

Managed Vegetation Habitat: Although saltgrass is the only plant species that will be deliberately introduced to the managed vegetation area, other plants species are expected to establish themselves opportunistically. Plant species observed on saltgrass test plots include sea blight (*Sesuvium verrucosum*), parry saltbush (*Atriplex parryi*), and rabbitfoot grass (*Polypogon monospeliensis*). The species typical of transmontane alkaline meadows elsewhere in the region, such as inkweed (*Nitrophila occidentalis*), Nevada sedge (*Scirpus nevadensis*), and yerba mansa (*Anemopsis californica*) would be expected to appear, adding diversity and wildlife habitat value to the fields. On saltgrass test plots established by the District on the playa, evidence of use by rabbits, rodents, insects, spiders, and even coyotes was found. The mosquito and salt cedar control programs discussed in Section 2–3.1.4 would also take place on the managed vegetation control measure.

Every effort will be made to limit the potential for introduction of exotic pest plant species into source emission areas that will be controlled through the use of managed vegetation. Test plots established on the playa have not been invaded by exotic pest plants. Fortunately, the existing saline soil conditions inherent to the lake bed are inhospitable to most plants including exotic pest plants such as tamarisk, puncture weed, pepperweed (*Lepidium latifolium*) and Russian thistle and noxious grasses such as *Cenchrus*. Exotic pest plants and noxious grasses will be removed from the source emission area (if present) prior to planting with saltgrass. Another potential source for the introduction of exotic pest plants would be from the saltgrass stands harvested for rhizomes to vegetate the panels. Exotic pest plants will be removed from the saltgrass stands (if present) prior to harvesting. Removal will be accomplished through an appropriate combination of biological, mechanical and chemical control methods. Berms and other elements of infrastructure will be constructed from lake bed soils, which are not likely to be subject to invasion from these pest plants due to the high levels of salinity. Due to the desire to vegetate as much of the lake bed as possible in order to provide effective PM_{10} control, livestock grazing will be prohibited in areas where managed vegetation will be used as a PM_{10} control measure.

Under the managed vegetation control measure, the application of water to panels has one of three fates after it is used to irrigate a panel: (1) if its salinity is within tolerance limits of the saltgrass that is planted on the panels, it is transported to another panel and applied to that panel; (2) if its salinity is above the tolerance limits of the saltgrass that is planted on the panels but low enough that mixing with fresh water can effectively reduce its salinity, it is transported to the reservoir (that also receives fresh water inputs) and mixes with water there; (3) at a specific threshold level (approximately 30 millisiemens), the salinity of the irrigation water is too high so that mixing with fresh water is undesirable; at this point, the water is transported to the lower portions of the managed vegetation site and is allowed to evaporate as a Saturated Evaporite Deposit (SED). This process mimics the natural processes that occur in the existing Owens Lake brine pool as waters from the Owens Valley drain to the lake basin and evaporate. There have been no known adverse impacts on wildlife resulting from these natural processes. As indicated on page 5-12 of the DEIR, the results of salt crust analysis indicate that metals currently on the lake bed are not present at toxic levels. Therefore, the application of water to the lake bed, and the subsequent potential for leaching of constituents within the lake bed soils, is not expected to result in the formation of water or soils within the managed vegetation control measures (including within the SED) that would exceed Total Threshold Limit Concentration (TTLC) levels and subsequently be deemed hazardous to wildlife or humans.

The District therefore concludes that the recirculation of water in the managed vegetation control measure will have no significant adverse effect on wildlife resources.

Managed Vegetation Construction Activities: Managed vegetation will require a water transmission, distribution, and drainage infrastructure as described above in Section 2–3.1.2, and presented in schematic form in Figure 2.12. It will also require the construction of access roads and water and flood control berms discussed in Section 2–3.1.3, as well as the provision for mobile and/or fixed recirculation pumps.

The primary transmission channel will be located along the upper edge of the PM_{10} emission area. Water delivery laterals will be constructed perpendicular to the primary channel, oriented towards the center of the playa (Figure 2.13). The fields will then be constructed parallel to the primary transmission structure, and will be built on contour. Field dimensions will be approximately 60-300 feet wide, and between ½-¾ of a mile long. Each field will be supplied independently with water from pipes which outlet from the laterals.

The primary transmission channel will be of earthen construction. This, and all other elements of the managed vegetation measure, will be constructed using methods developed by Agrarian Research and Management during a research project conducted on the Owens Lake playa (Agrarian Research and Management, 1997). The laterals will be small-scale versions of the primary transmission structure, and construction methods would be similar. These, and the roads associated with them, will be the first elements of the measure to be constructed. Drains will be excavated at intervals appropriate to the soil structure and texture, and will be placed on contour between field blocks, and also at the distal end of the fields. Fields will be built on elevation contours. Each one will have a small flow-regulating basin at the top of the field where the irrigation water enters. The flow-regulating basin will connect to a head ditch that defines the up-slope boundary of the field. Fields will be separated from each other by low berms.

All drains serving a block of fields would be connected together. Ramps will be installed in the drain network to accommodate recirculation pumps. These pumps will be attached to mobile power units, and can be situated where the drain water can be either pumped into a discharge lateral for removal to a sump, be directed into a connecting conveyance for use on a shallow flooding parcel, or be recirculated to the primary distribution channel for reuse.

Managed Vegetation Operation and Maintenance Activities: Managed vegetation is predicted to utilize approximately two ac-ft/yr of water per acre controlled. The distribution of the water over the entire vegetated area will be irregular, because at any given time some fields will be irrigated for maximum growth while others will be receive minimal amounts of water allowing for minimal stand maintenance. Water use will be higher during the initial stages of development of this measure, as it will take 3½-6 feet of water to leach the top two feet of soil to a salinity level tolerable to saltgrass (Ayars, 1997).

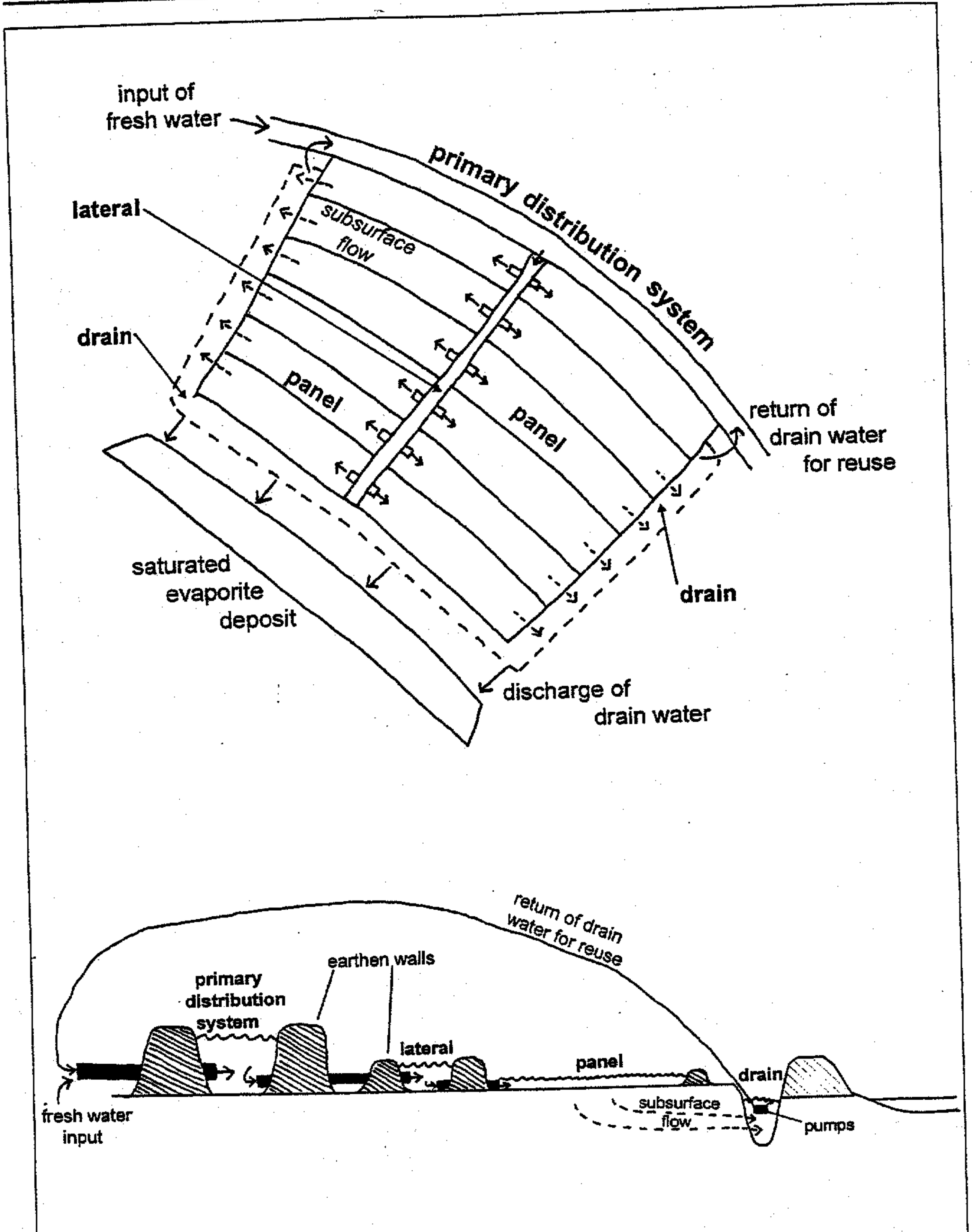


Figure 2.12: Managed vegetation - conceptual water delivery schematic.

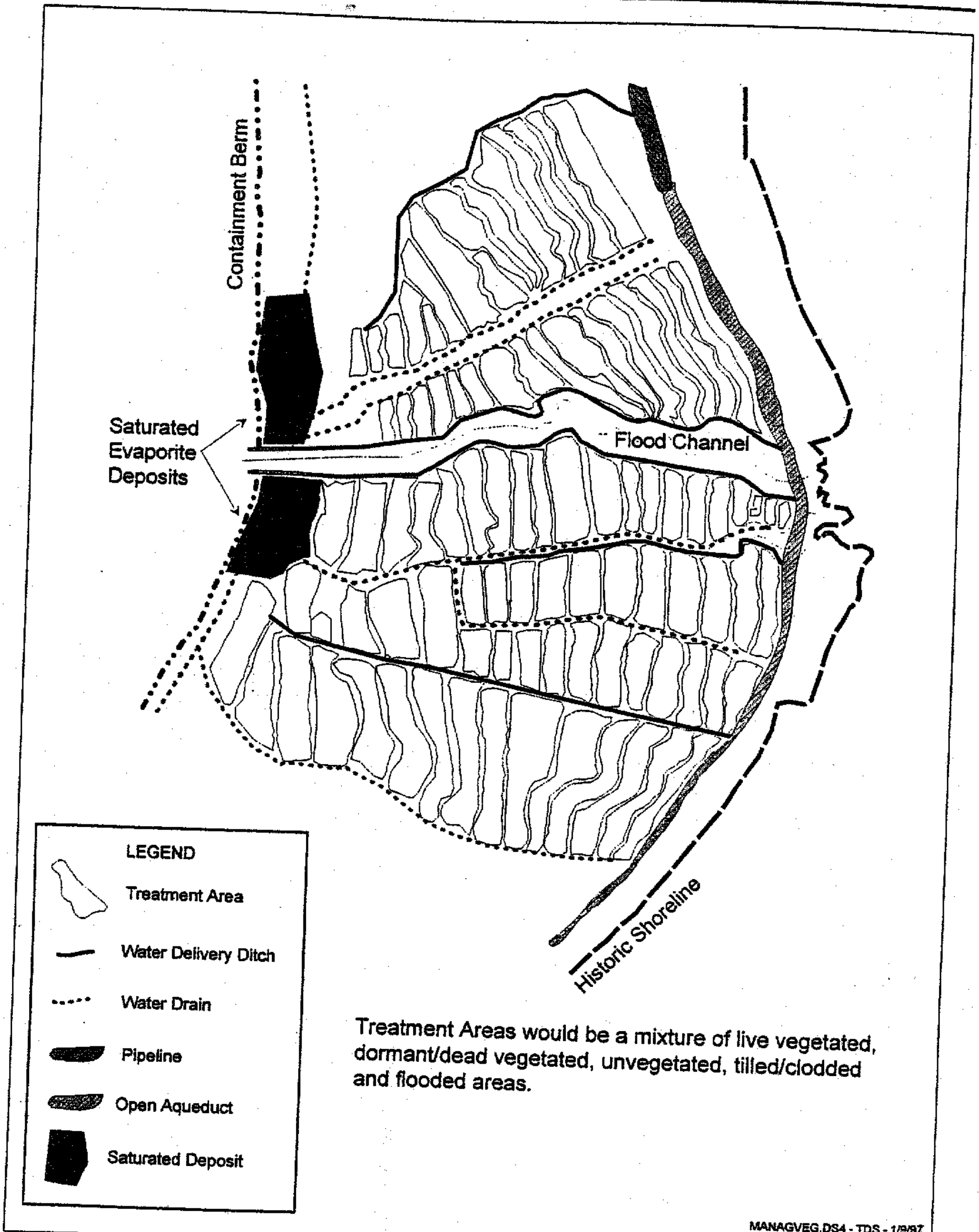


Figure 2.13: Managed vegetation - conceptual control measure components.

Operation and maintenance activities for managed vegetation would consist of implementing an irrigation schedule for the fields, and necessary repair to water transmission and delivery structures and to the berms and ditches associated with the fields. Staffing requirements for operation and maintenance of the managed vegetation area are estimated at approximately one FTEE per 1,500 acres of vegetated area.

2–3.1.7 Mandatory Elements of the Managed Vegetation Control Measure

In Area D (as shown in Figure 2.19), the City shall achieve coverage of at least 50 percent of each acre in substantially evenly distributed live or dead vegetation, as measured by the point-frame method. The vegetation shall consist only of locally-adapted native species or species approved by both the District and the State Lands Commission.

The following portions of Area D are exempted from the requirement of 50 percent vegetative coverage: (a) portions of Area D consistently inundated with water, such as reservoirs and canals; (b) roadways necessary to access, operate and maintain the control measure which are otherwise controlled to render them substantially non-emissive; (c) portions of Area D used as floodwater diversion channels or desiltation/retention basins; and (d) portions of Area D set aside as Transmontane Alkaline Meadow (TAM) habitat restoration zone which meet the requirements set forth below.

In Area D, a minimum of 121 acres of the control area (less any offsets) must be established as a habitat restoration zone for TAM, vegetated to achieve species diversity and achieving vegetative cover comparable to TAM. Any TAM established and maintained by the City in control areas using shallow flooding, shall be an acre-for-acre offset to this habitat restoration provision.

The City shall remove any exotic pest plants, including salt cedar (*Tamarix ramosissima*) and pepperwood (*Lepidium latifolium*), that invade the control area. To the extent necessary to protect human health, the City shall avoid or abate mosquito breeding and swarming in those control areas by means which minimize adverse effects upon adjacent wildlife.

To protect the control measure from natural flooding, the City shall incorporate drains and channels in the control measure areas adequate to divert the flood waters away from the vegetated areas and into the Owens Lake brine pool or into control area storage reservoirs, if any. The drains and channels shall be designed to incorporate features such as desiltation/retention basins adequate to capture the alluvial materials carried by the flood waters and to avoid greater than normal deposition of this material into the Owens Lake brine pool.

The City shall construct a berm keyed into the lake bed sediments along the lower boundary of each of Area D to minimize the transmission of excess water from the control area toward the Owens Lake brine pool. The design and implementation of this berm will incorporate snowy plover crossings located at each 500 feet along the length of the berm, adequate in design to freely allow traverse of the berm by both snowy plover adults and chicks. Surface waters that reach the lower boundary of those control areas will be collected and recirculated for reapplication to the control area or other discharge. The control measure areas will have lateral boundary edge berms as necessary to contain waters in the control areas and to isolate the control measure areas from each other and from areas not controlled.

2–3.1.8 Gravel Extraction, Transportation and Reclamation

Gravel Source Selection Process: The following information is summarized from the report "Preliminary Assessment of Gravel Sources for the Owens Lake Playa PM_{10} Emission Abatement Project," (EMA, 1996) which is provided as Appendix C to this EIR.

For this assessment, the term "gravel" was assumed to include sized clasts from both fluvial and alluvial sources and crushed stone. Gravel for use in abating PM_{10} emissions from the surface of the Owens Lake playa need not meet the typical criteria of gravel used for construction because it would not bear loads nor be exposed to traffic. The only established criteria are that the gravel clasts should be larger than ⅜-inches in size, that they be able to resist leaching and erosion from wind and infrequent rain and that they be of a color that does not significantly change the color of the existing lake bed. In order to allow for efficient spreading of the gravel material, the upper size of the gravel clasts should be less than four inches, but all gravel larger than ⅜-inch is permissable. In addition to the substantial quantities of gravel necessary to directly abate PM_{10} emissions from the Owens Lake playa, gravel would be required to surface the roads and backfill the pipeline trenches which may be constructed on the Owens Lake playa to support the PM_{10} control measures.

The process of identifying potential sources of gravel for the Proposed Project commenced with an initial screening to select candidate sources. Three classes of candidate gravel sources were initially identified using the general criteria of: (a) level of knowledge regarding the gravel source and reserves; (b) speed and cost of development; and (c) cost of production. These three classes were: (a) existing commercial gravel sources within the greater Owens Valley/Indian Wells Valley area, which were well characterized and could likely supply gravel quickly without substantial additional expenditures for development; (b) previously utilized or previously developed sources of gravel in the general vicinity of the Owens Lake playa, that were also reasonably well characterized but would likely require substantial expenditures of time and money to develop as a reliable Project gravel source; and (c) previously unidentified and undeveloped gravel sources to the immediate east and south of the Owens Lake playa, closest to the points of use, which were not previously characterized and would also likely require substantial expenditures of time and money to develop as a reliable gravel source.

The initial screening of gravel sources based upon these criteria identified fifteen potential candidate sources: four existing commercial gravel/crushed stone operations; six previously utilized or previously developed gravel sources; and five previously unidentified and undeveloped gravel sources. These potential candidate sources were then evaluated in greater detail on several criteria: (a) reserves information (type of material, percentage of clasts greater than ⅜-inch, quantity of reserves, etc.); (b) environmental issues (both for the source location and the delivery route); (c) potential development costs (for undeveloped sources only, including potential production equipment costs, delivery road development, reclamation costs, and development time); and (d) production costs (either purchase price and transportation costs, for developed commercial sources, or costs to produce, load and transport for currently undeveloped sources). Because gravel is relatively inexpensive to develop and produce, but relatively expensive to transport, the distance from the source to the project area (assumed to be the junction of Sulfate Road and SR 136, south of Keeler) becomes a significant factor in the overall cost of delivered gravel.

Identified Potential Sources of Gravel: After comparing the estimated cost of delivered gravel for each of the identified candidate gravel sources against any identified environmental issues and the ability of the source to supply a substantial portion of the required quantity of gravel (approximately 2.8 million cubic yards) required for the Project, the three candidate sites described below were selected as the potential gravel/crushed stone sources. The potential gravel source locations are identified on Figure 2.14.

It is not the intent of this document to select the actual source of gravel for the project, but rather to analyze the feasibility of local gravel mining and transportation and the impact of the gravel on the lake bed. Securing gravel for the project will be the responsibility of the City of Los Angeles. The City may select to secure the gravel from any number of locations. It may be obtained from local quarries developed specifically for the project; it may be obtained from existing private or local City of Los Angeles quarries; or it may be obtained from out of the area and transported to Owens Lake. It is anticipated that before gravel mining and transportation begin at any site, additional field surveys, environmental impact analyses, planning and permitting will be necessary before the required permits are secured. This includes any National Environmental Policy Act (NEPA) requirements for work on federal lands and any requirements of the Surface Mining and Reclamation Act (SMARA). Depending on the location of the gravel source, approval from the BLM and/or Inyo County will be required.

The potential gravel sites described below are only three of the possible sites from which the gravel needed to control PM_{10} emissions could be extracted. They indicate that local sites are available for the production of gravel and that local production is feasible. For the purposes of some impacts analyzed and for the purposes of cost estimates, it was projected that the Keeler Fan site would be used as the source of the gravel.

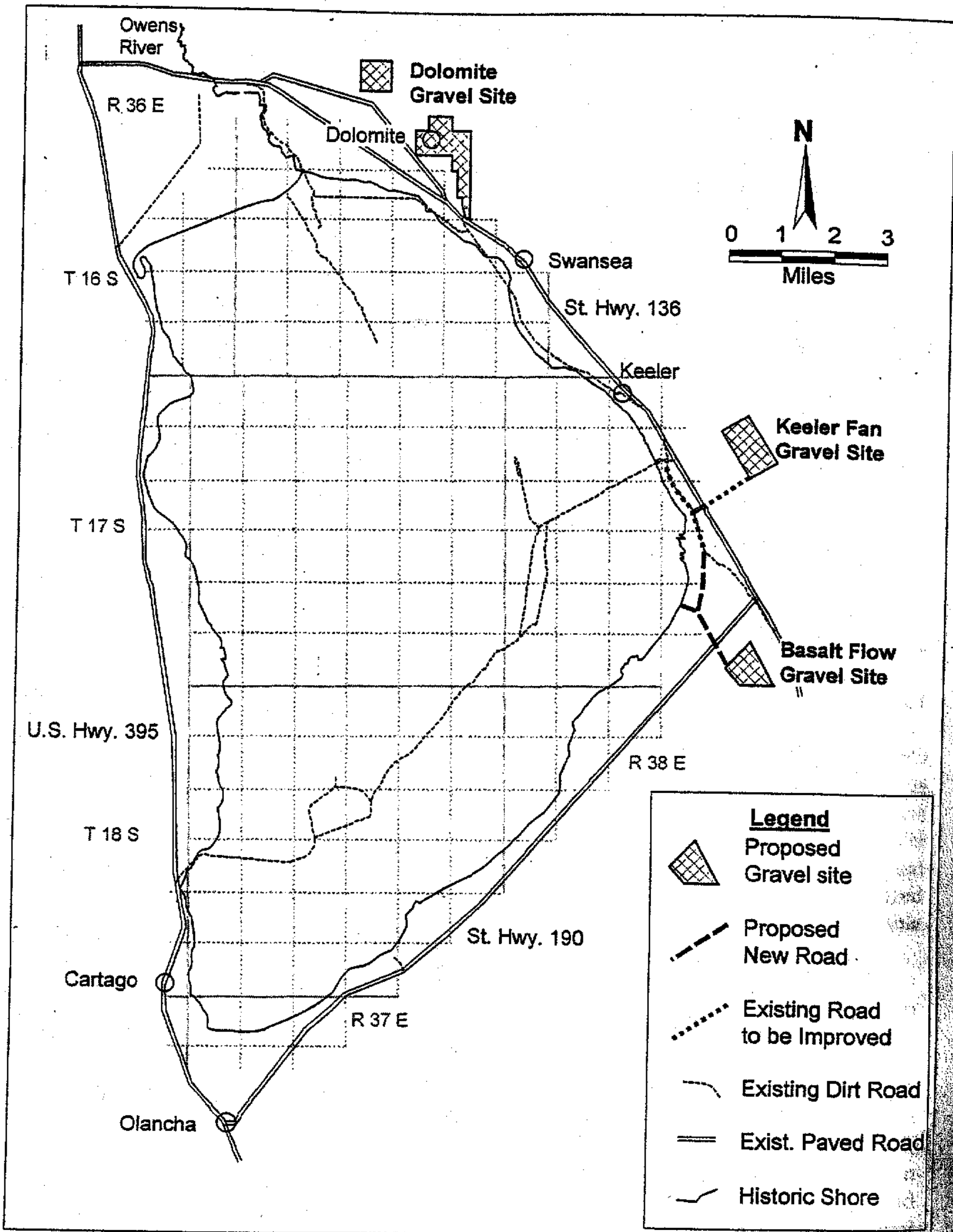


Figure 2.14: Potential gravel source locations.

Basalt Flow (***Undeveloped Potential Source #4***): This potential source is an undeveloped basalt flow located on public lands managed by the Ridgecrest Resource Area Office of the BLM. At its closest point it is located approximately 1½ miles southeast of the Owens Lake playa and 0.3 miles south of SR 190, approximately six road miles south of Keeler and approximately one road mile from the junction of SR 190 and SR 136 (Figure 2.15). The basalt flow covers an area of approximately 900 acres within a potential development area of 2,020 acres, consisting of portions of Sections 26, 35 and 36, T.17S., R.38E., and Section 2, T.18S., R.38E., MDB&M. The size of the area shown within the boundary in Figure 2.15 that would be required for development as a gravel source is approximately 140 acres. The elevation of the site at its lower edge, closest to SR 190, is approximately 3,800 feet, but rises to an elevation of approximately 4,000 feet in the southeastern corner.

The southwest corner of the potential site contains a small side-canyon in which a recent sand dune has formed as material blows off the Owens Lake bed. Site activities will take place north of this dune and it will be avoided during all mining that may occur at this site.

Keeler Fan (***Undeveloped Potential Source #6***): This potential source is an undeveloped alluvial fan also located on public lands managed by the Ridgecrest Resource Area Office of the BLM. It is located less than two miles east of the Owens Lake playa and less than one mile east of SR 136. The access road to this source is approximately three miles south-southeast of Keeler (Figure 2.16). The alluvial fan material covers an area of approximately 1,550 acres within a potential development area of 1,720 acres, consisting of portions of Sections 2, 11 and 14, T.17S., R.38E., MDB&M. The area shown within the boundary in Figure 2.16 that could be developed as a gravel source would be approximately 400 acres, although only about 150 acres would need to be developed to produce the 2.8 million cubic yards of gravel needed for the Proposed Project. The elevation of the alluvial fan at its lower edge, closest to SR 136, is approximately 4,000 feet. At its upper end, as it extends up into the lower levels of the Inyo Mountains, the fan rises to an elevation of approximately 4,250 feet.

Dolomite Rock Quarry: This potential gravel source is an active dolomite rock quarry that originally dates back to the 1800's. It is now operated by Federal White (F.W.) Aggregate on both private lands and public lands managed by the Bishop Resource Area Office of the BLM. It is located seven miles southeast of Lone Pine off SR 136 on the Dolomite Loop Road, approximately one mile northeast of the Owens Lake playa and approximately seven miles northeast of Keeler (Figure 2.17). F.W. Aggregate controls approximately 2,000 acres of private and public land which could be developed, although only approximately fourteen acres have been developed to date. Gravel required for the project could come from the private land holdings. These private lands are shown in Figure 2.17. The elevation of the existing quarry site is approximately 4,000 feet.

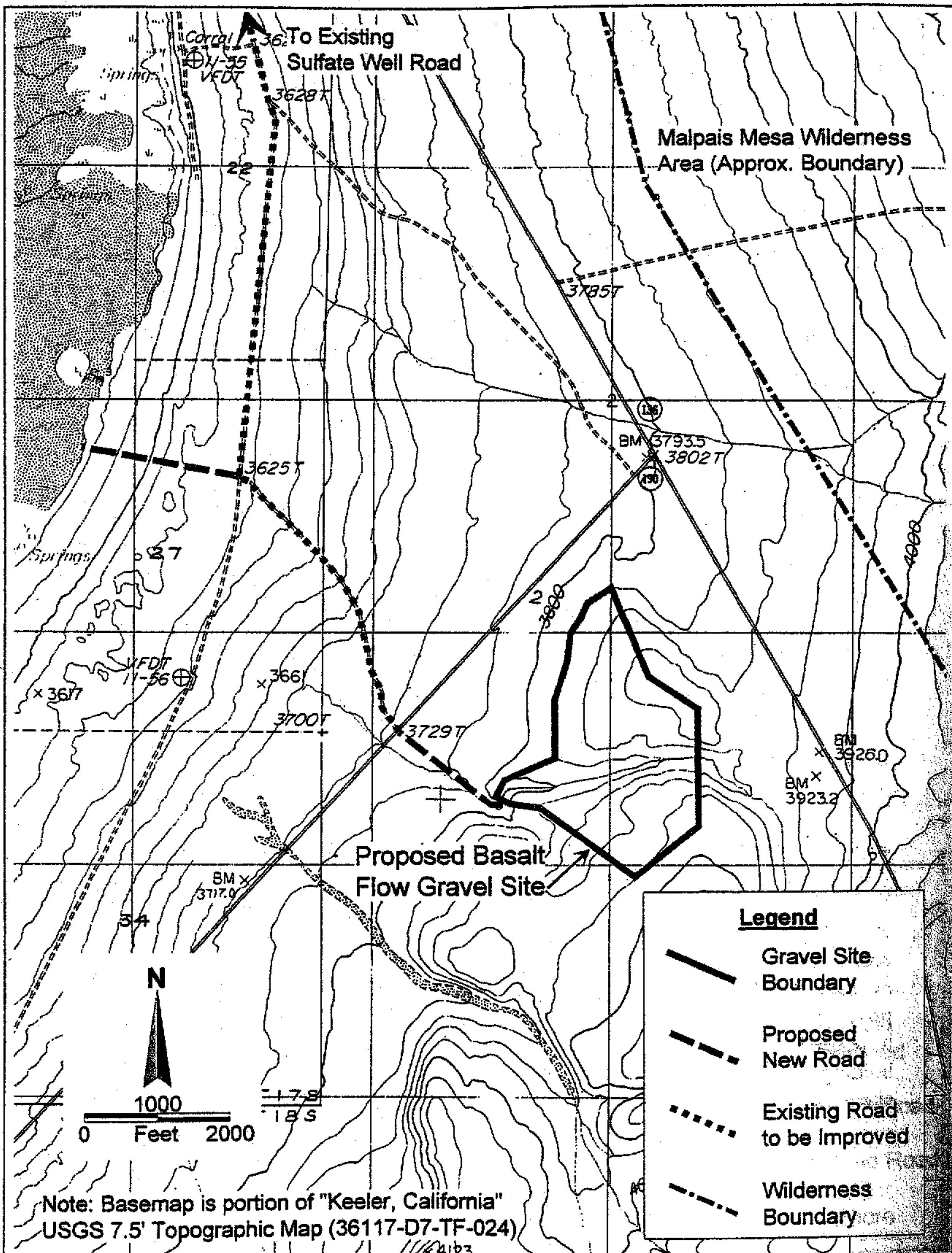


Figure 2.15: Potential gravel source - Basalt Flow.

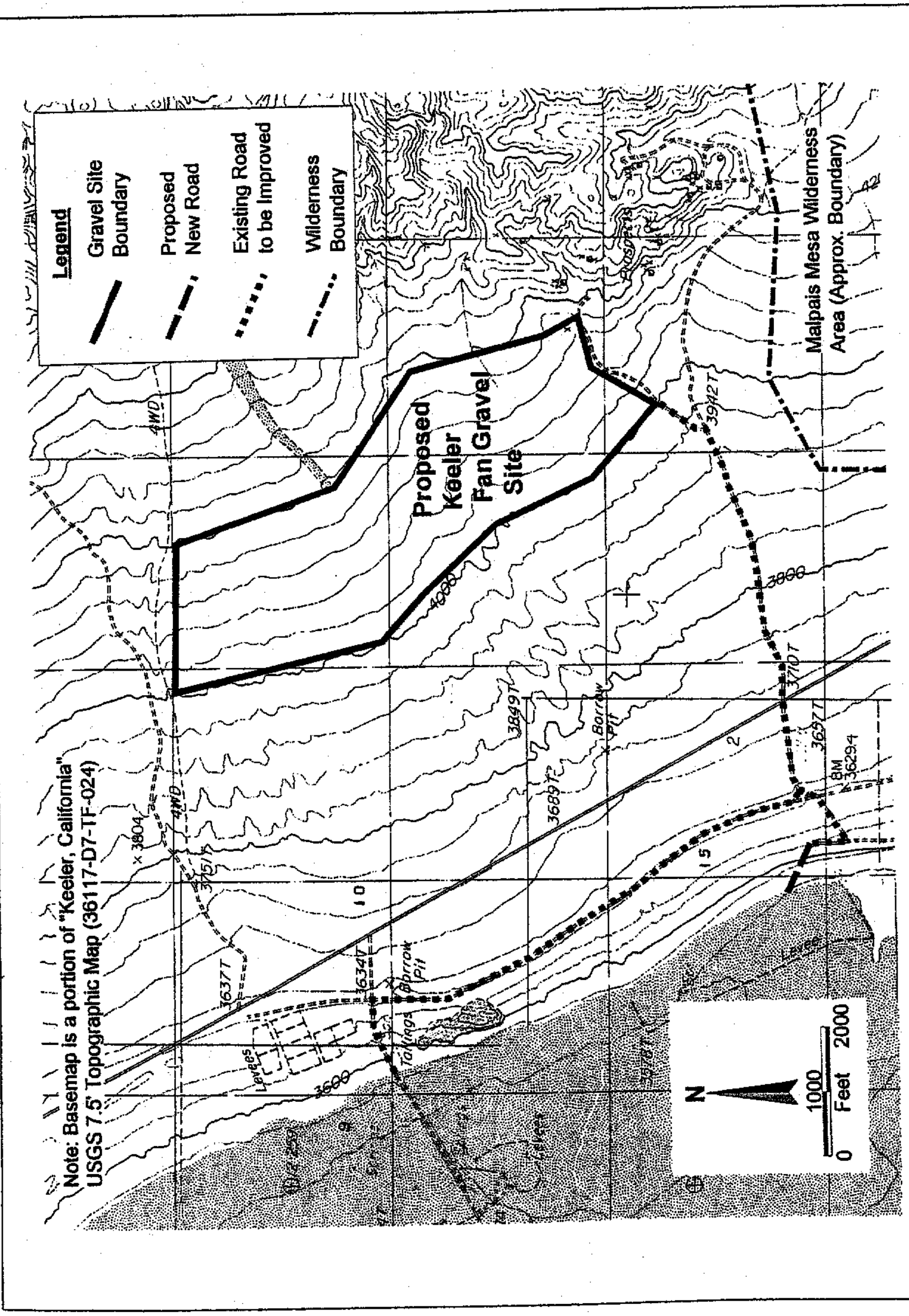


Figure 2.16: Potential gravel source - Keeler Fan.

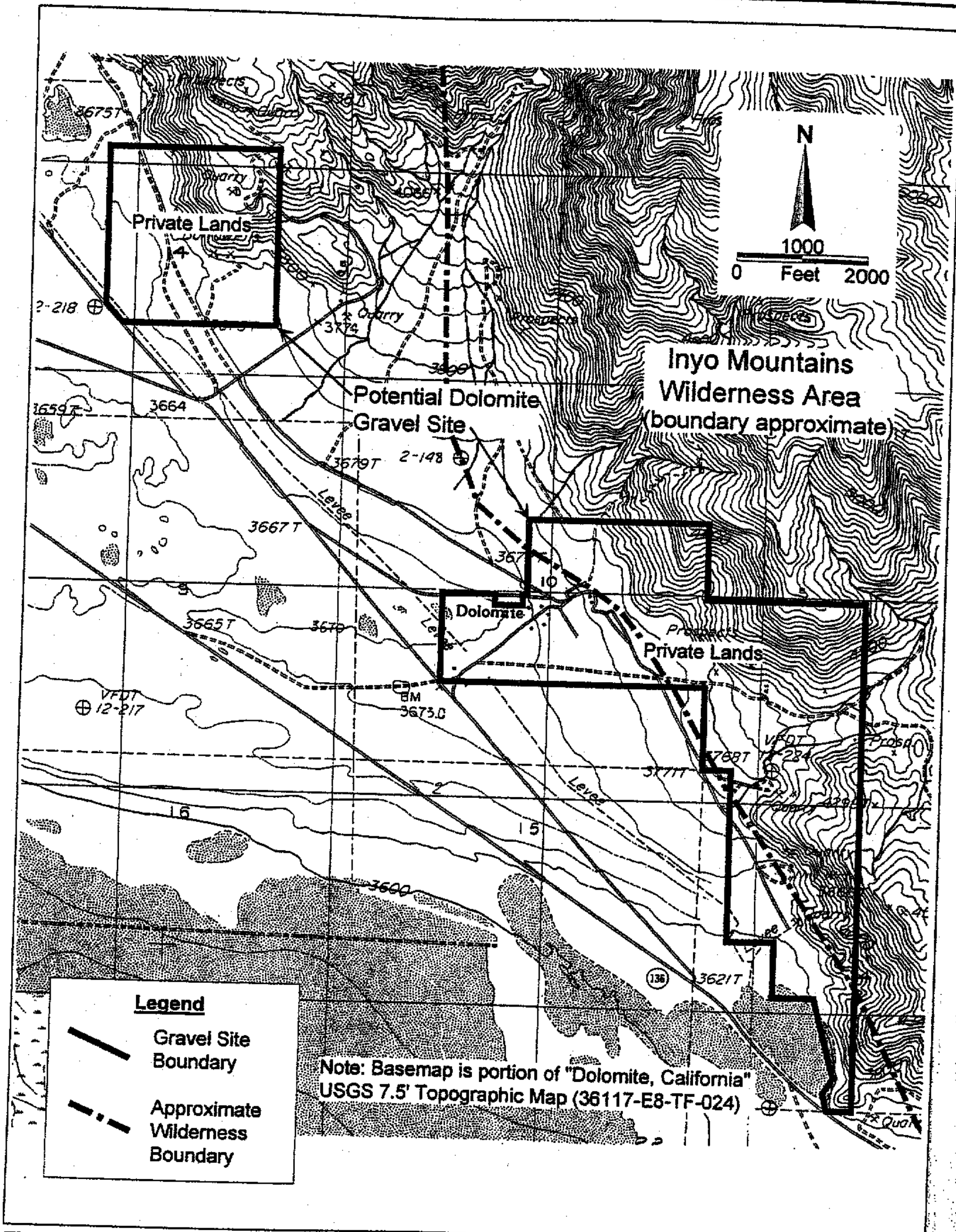


Figure 2.17: Potential gravel source - Dolomite.

Gravel Extraction Processes and Operations: The gravel production processes described below are some of the possible methods of providing the gravel needed to control PM_{10} emissions. They are not the only methods of providing the required gravel, but they show the feasibility of local gravel production, they allow an analysis of the environmental impacts and make it possible to prepare preliminary cost estimates. It is anticipated that before actual gravel mining and transportation begins, additional field surveys, analyses and planning may be necessary before the required permits are secured.

Basalt Flow: The production of gravel (crushed stone) from this potential source would consist of the removal of the rock from the basalt flow; the sizing of the rock; and the possible stockpiling of the produced rock and any waste rock material. Facilities required to produce the crushed rock include the rock extraction area; a crushing and sizing plant; product and waste rock stockpiles; extraction, loading, and hauling equipment; a system of access roads; a small facility administration and equipment maintenance area; a source of electricity for plant operations; above-ground storage tanks for equipment fuel; and a source of water for dust control. Each of these facilities would be constructed at the potential gravel source site.

Extraction operations would begin on the westernmost side of the source site nearest SR 190, and extraction would proceed to the north, south and east. Access to the source site would be gained from SR 190 through the construction of an approximately 0.3-mile gravel road approximately 80 feet in width, or enough to accommodate two-way haul truck traffic. As gravel extraction operations continue, additional access roads would need to be constructed throughout the source area. For each 100 acres of developed basalt flow, an estimated total of approximately one mile of additional access roads would need to be developed in the disturbed source area. These would also be gravel roads approximately 80 feet in width.

Construction of the gravel source extraction facilities would commence once necessary approvals are obtained from the appropriate regulatory agencies (see Section 1–4). After all necessary permits are obtained, it would take approximately 90-120 days to construct the initial extraction facilities. Additional construction activities would occur over the life of gravel extraction operations.

Either or both of two methods, ripping and/or blasting, may be utilized to initially remove the rock from the face of the basalt flow. Ripping would be conducted by a large bulldozer with a ripping attachment, which tears away fractured rock from the face of the flow to a depth of less than six feet. Blasting with explosives may be necessary to loosen the rock from some of the basalt flow if the rock is not sufficiently fractured and ripping with a bulldozer is not possible or efficient. If blasting is used, a mobile rotary drilling rig would be used to drill approximately 50, 6-inch± diameter holes spaced on approximately 14-foot± centers over an area of approximately 8,000 square feet. The holes would be filled with a common blasting agent, most likely a mixture of ammonium nitrate and fuel oil (ANFO) and detonation charge. After securing the area, the rock would be blasted. All blasting would occur only Monday through Friday during daylight hours. Blasting can be expected to occur, at most, once per day and blast noise duration will last less than five seconds.

Blasting of 8,000 square feet of a 40-foot bench produces approximately 14,000 cubic yards of raw crushed stone. The extracted rock would either be loaded with a loader directly into the crushing plant or, as operations progress, into one or more haul dump trucks to be hauled to the crushing plant. The loader and the haul trucks would be sized to match the design throughput of the crushing plant. The crushing plant would size the material to range from ⅜-6 inches in diameter through one or more crushers and/or screens. The crushing plant would occupy an area of 2-4 acres, depending on the amount of sizing required and the design throughput of the plant. It should be noted that due to the hard, rough nature of basalt, mining costs can be significantly higher than mining costs associated with other types of rock.

The produced rock would be either immediately transported from the site to the Owens Lake playa (Section 2–3.1.7) or temporarily stockpiled to a height of less than 25 feet in an area of less than five acres on-site until transported to the Owens Lake playa. Because of the nature of the source material, a minimum amount (< 5%) of waste materials (materials < ⅜-inch size) are expected to be produced. These waste materials would be stockpiled on site in a waste rock stockpile requiring approximately four acres for the 2.8 million cubic yards of crushed stone required (assuming 5% waste and a waste rock stockpile height of 25 ft).

Extraction site support facilities would include an office trailer; a water truck; one or more pickup trucks; a small vehicle maintenance area, including an above-ground fuel and lubricant storage area; an explosives magazine (if blasting is used); an electrical transmission line; and a water supply pipeline. Diesel fuel and fresh and waste equipment lubricants would be stored on-site; diesel fuel in one or more above-ground tanks of 10,000 gallons or less, and lubricants in one or more 500-gallon tanks or 55-gallon drums. Diesel fuel and fresh and waste lubricant containers would be all be stored within concrete bermed pad(s). Diesel fuel consumption is estimated at approximately 1,000 gallons per 10,000 cubic yards of crushed stone produced. If blasting is used, the blasting agents would be stored in compliance with U.S. Bureau of Alcohol, Tobacco and Firearms (BATF) safety standards. The consumption of blasting agents is estimated at approximately five tons per 10,000 cubic yards of crushed stone produced.

Electrical energy to run the crushing plant and the office trailer would be supplied from a transmission line constructed adjacent to the access road from existing lines (adjacent to SR 190 or constructed by the Proposed Project for the PM_{10} abatement facilities). Peak electrical power requirements are expected to be approximately 375 kW (500 hp) for each 200 cubic yards (300 tons) per hour of processing capacity.

Site water requirements and water for dust control would be supplied from the lake bed project water supply system to the mining site via a pipeline (diameter approximately 2") also constructed in the site access road. If a conveyor system is used to transport the gravel to the lake bed, the water line would follow the conveyor route. An electrical booster pump would be required on the lake bed to deliver the water to the mining site. Peak water consumption is estimated at approximately 60,000 gallons (0.18 acre-feet) per 10,000 cubic yards of crushed stone produced or 50 acre-feet (ac-ft) total for the 2.8 million cubic yards of gravel needed.

Mobile equipment necessary for site operations would include bulldozer(s), loader(s), water truck(s), haul truck(s), and lightweight service vehicles. Operation of a facility with 200- to 400-cubic yards per hour design rate processing capacity would employ an estimated ten workers during any given shift, depending on the number of haul trucks needed and the distance they may travel. Noise levels during all site construction and source extraction operations except blasting are expected not to exceed 85 dBA at a distance of 100 feet from the blast site. Blasting would take place only Monday through Friday during daylight hours. Extraction operations would be conducted 24 hours per day, seven days per week. Gravel hauling from the basalt site would take place 24 hours per day, seven days a week for gravel used south of Keeler. Any gravel hauled north of Keeler would be hauled only during daylight hours, Monday through Friday.

It is anticipated that proposed gravel source site reclamation may include measures for: (a) protecting wildlife and the public; (b) minimizing erosion; (c) demolishing structures; and (d) producing reclaimed areas which are visually and functionally compatible with the surrounding topography. Reclamation procedures required by the reclamation plan to be secured by the City of Los Angeles may include:

- Establishing a stable topographic surface with drainage conditions that are compatible with the surrounding landscape and serve to control erosion.
- Using concurrent or "haul back" reclamation to reclaim the site as it is being mined. This technique minimizes the impacts of a borrow pit remaining unclaimed for a number of years while the mining takes place.
- Providing for public safety through stabilization, removal, fencing, and/or berming of structures or landforms that could constitute a public hazard.
- Minimizing the outward regrading or reshaping of slopes to reduce further impacts to undisturbed habitat.
- Enhancing the long-term visual character of the reclaimed area.
- Implementing a specific reclamation measure for the basalt site that includes leaving a number of stable, rough, steep rock faces in the basalt to serve as potential roosting habitat for bats observed foraging in the area (Section 3–5.3.2.4).

Keeler Fan: The production of gravel from this site would be conducted in a manner very similar to that described above for the Basalt Flow potential source, except as explained below.

Extraction operations would begin adjacent to the existing access road on the southeast end of the potential source area, and would proceed to the northwest. The access road would need to be widened to approximately 80 feet, sufficient to accommodate two-way truck traffic. Gravel is expected to be extracted exclusively using ripping, although there is a possibility that limited blasting may be necessary in some areas. If blasting is necessary, it would occur only Monday through Friday, during daylight hours.

Because of the nature of the alluvial materials, only a screening plant (no crushing plant) is anticipated as necessary to size the material to conform to the ⅜- to 4-inch criteria. Because of the nature of the source material, approximately 40 percent of processed material at this site is estimated to be waste materials (or 67,000 cubic yards of waste materials < ⅜" or > 4" in size per 100,000 cubic yards of gravel). These waste materials would be stockpiled on-site in one or more waste rock stockpiles requiring approximately two acres for each 100,000 cubic yards of gravel produced (assuming 40 percent waste and a waste stockpile height of 25 ft) or a total waste area of 56 acres for the 2.8 million cubic yards of gravel required.

Dolomite Rock Quarry: Extraction operations would likely be conducted at a location on the F.W. Aggregate property separate from the existing operation, which is directed to producing relatively small quantities of distinctively different decorative rock on demand. The specific activities conducted and the quantities of resources required to produce gravel (crushed stone) from this potential source would be identical to those required for the Basalt Flow potential source, as described above.

Gravel Transportation Operations: The processed gravel may be transported from the extraction area to the gravel cover areas on the Owens Lake playa by one or more of the following methods: (a) standard highway gravel trucks; (b) larger off-highway trucks; or (c) a conveyor system. Standard highway gravel trucks consist of a truck and attached trailer which together generally transport up to approximately 25 tons (sixteen cubic yards) of gravel. Off-highway trucks can transport gravel loads from 30 to 300 tons in size, although these trucks may require special road beds on which to operate, and are not typically authorized to travel on standard state highways or county roads. Conveyor systems, which consist of one or more interconnected moving belts, can be designed to transport gravel at essentially any rate. Although these systems are typically built in fixed locations, moveable systems are available. The benefit of using conveyor systems at the basalt or Keeler Fan sites is that due to the fact that the gravel is being hauled downhill, site electrical power can be generated by the falling gravel material. In addition, conveyors do not have the noise or dust impacts associated with truck transport.

Gravel mined from sites south of Keeler (Basalt Flow and Keeler Fan sites) would be hauled to areas on the lake bed south of Keeler 24 hours a day, seven days a week. To limit noise and traffic impacts on the Keeler area, gravel from these sites destined for areas north of Keeler would be hauled Monday through Friday during daylight hours only. Gravel destined for lake bed areas south of Keeler and mined from the Dolomite source would also haul Monday through Friday, during daylight hours only.

It is estimated that at a production/transportation/spreading rate of 200 to 400 cubic feet of gravel per hour, that it would take 1½-3 months to cover one square mile of lake bed (approximately 344,000 cubic yards of gravel per square mile) if gravel is hauled 24 hours per day. Other installation rates or limitations on hauling hours (such as for the Dolomite site) would take proportionally different times.

Basalt Flow: One mode that could be used to transport the processed gravel from this potential source area would be off-highway trucks of a size (on the order of 85 tons load capacity) dictated by economics and the process rate and the distance to the delivery point on the Owens Lake playa. Trucks would drive down the extraction area access road and cross SR 190 on an overweight vehicle crossover designed and constructed to CalTrans standards. CalTrans may also require the installation of a traffic signal at the SR 190 crossover point. Trucks would then either continue straight on the existing service road to the Owens Lake playa, or turn north along the old state highway to Sulfate Road, then onto the Owens Lake playa. Both the existing service road straight onto the Owens Lake playa (approximately one mile) and the old state highway to Sulfate Road (approximately three miles, plus ½-mile of the service road) would require substantial upgrading to allow use by these heavy off-road trucks. Delivery of approximately 250 cubic yards per hour could be accomplished with four haul truck driver per any given shift, depending on the size of the haul truck and the standing time required for loading and unloading. Diesel fuel required to deliver 10,000 cubic yards of gravel is estimated at 600 gallons (CAT 777c).

A conveyor system would also be a viable alternative method of gravel transportation to the Owens Lake playa from this site. The conveyor system would extend from the processing facility/processed gravel stockpile at the basalt flow along an approximately 1½-mile route, which would parallel the access road and the service road, to the edge of the Owens Lake playa, and possibly continue on to the application point on the Owens Lake playa itself. Such a conveyor system would typically consist of several belts, each approximately 2,000 feet long. The conveyor would pass under SR 190 in a large-diameter corrugated steel pipe (CSP) tunnel. Operation of the conveyor system would require about three workers per any given shift. Electrical power requirements to operate the conveyor system are estimated at 110 kW (150 hp) to deliver up to 400 cubic yards of gravel per hour, unless power generating conveyors are used, in which case on-site electricity requirements could be reduced significantly.

Keeler Fan: One mode that could be used to transport the processed gravel from this source area would be off-highway trucks. Trucks would drive down the extraction area access road and cross SR 136 on an overweight vehicle crossover, possibly with a signal. Trucks would continue straight on an existing service road, then turn north along the old state highway to Sulfate Road, then onto the Owens Lake playa. Both the existing service road (approximately ⅓-mile) and the old state highway to Sulfate Road (approximately 1½ miles) would require substantial upgrading to allow their use by these heavy off-road trucks.

A conveyor system would also be a viable alternative method of transportation to the Owens Lake playa from this site. The conveyor system would extend from the processing facility/processed gravel stockpile at the extraction area along an approximately ½-mile route that parallels the access road and the service road to the edge of the Owens Lake playa, and possibly continue on to the application point on the Owens Lake playa (Section 2-3.1.7). As with the basalt site, the conveyor would pass under SR 136. The comparative cost estimates prepared for the Proposed Project and the Project Alternatives used conveyor transport from the Keeler Fan site as the basis of the developed estimates.

Labor, fuel, and electrical requirements would be similar to that required for the Basalt Flow potential gravel source.

Dolomite Rock Quarry: The most likely mode to transport the processed gravel from the Dolomite Rock Quarry to the playa application point would be the use of standard highway trucks/trailers traveling along SR 136 through Keeler to Sulfate Road, then out to the Owens Lake playa, a total distance of approximately nine miles. Delivery of up to approximately 200 cubic yards per hour would require up to thirteen haul truck drivers per any given shift (assuming one load per hour per truck), depending on the standing time required for loading and unloading. Diesel fuel required to deliver 10,000 cubic yards of gravel is estimated at 3,000 gallons.

If an alternative off-highway access road is constructed on the Owens Lake playa from the Dolomite Rock Quarry area as part of the project infrastructure, larger, off-highway trucks could be used, necessitating the construction of the same structures to cross SR 136 as described above. Because of the relatively long distance from the Dolomite Rock Quarry to the gravel application point, a conveyor system is not practical.

2–3.1.9 Gravel Cover PM_{10} Control Measure

A four-inch layer of coarse gravel laid on the surface of the Owens Lake playa will prevent PM_{10} emissions by: (a) preventing the formation of efflorescent evaporite salt crusts, because the large spaces between the gravel particles interfere with the capillary forces that transport the saline water to the surface where it evaporates and deposits salts; and (b) raising the threshold wind velocity required to lift the large gravel particles (i.e., larger than ⅜- inch diameter) so that transport of the particles is not possible by wind speeds typical of the Owens Lake area. Gravel blankets can work effectively on essentially any type of soil surface. Figure 2.18 is a photograph of one of the District's gravel test plots on Owens Lake. These test plots have been in place for approximately 10 years and continue to completely protect the emissive surfaces beneath. Gravel placed onto the lake bed surface will be durable enough to resist wind and water deterioration and leaching and will be approximately the same color as the existing lake bed.

For the purposes of impact analyses and the preparation of cost estimates, it was projected that the Keeler fan site would be the source of the gravel used for the gravel PM_{10} control areas.

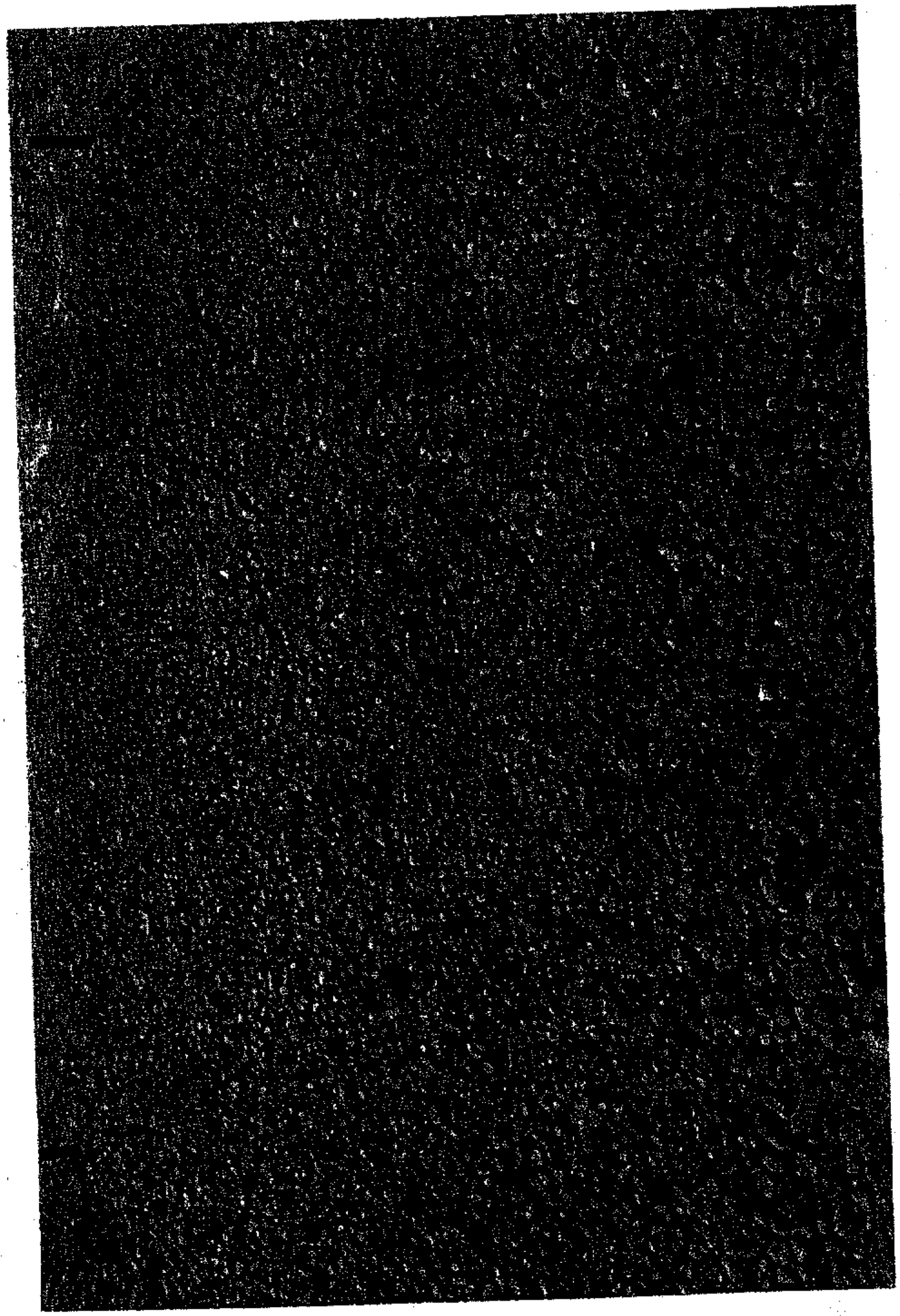


Figure 2.18: Gravel cover - test site photograph.

Under certain limited conditions of sandy soils combined with high groundwater levels, it may be possible for some of the gravel blanket to settle into lake bed soils and thereby lose effectiveness in controlling PM_{10} emissions. To prevent the loss of gravel material into lake bed soils, a permeable geotextile fabric may be placed between the soil and the gravel where necessary. This will prevent the loss of gravel (Law/Crandell, 1997).

Gravel areas must be protected from water- and wind-borne soil and dust. The gravel blanket will be the last control measure to be installed. Therefore, wind-borne depositions will be eliminated. Gravel areas will also be protected from flood deposits with flood control berms, drainage channels and desiltation/retention basins. These measures will ensure that the gravel blanket will remain an effective PM_{10} control measure for many years.

To attain the required PM_{10} control efficiency, 100 percent of all areas designated for gravel must be covered with a layer of gravel at least four inches thick. Gravel particles shall be larger than ⅜-inch in diameter, and where necessary to prevent loss of gravel material into the lake bed soils, the gravel blanket shall be placed over a permeable geotextile fabric. The gravel material shall be at least as durable as the rock from the three sources analyzed in this document. The material shall have no larger concentration of metals than found in the materials analyzed in this document. The color of the material used shall be such that it does not significantly change the color of the lake bed.

Construction Activities: Gravel could be placed on the Owens Lake playa from trucks or conveyors/stackers. Application of the gravel on the Owens Lake playa by truck would likely occur only if the gravel is transported to the playa by truck, and the transportation truck could be used to deliver the gravel directly to the utilization site without additional loading, unloading or handling. Application by truck would require the construction of a network of access roads for the trucks in the area for gravel application, because much of the playa surface is not capable of supporting loaded truck during certain times of the year. Gravel access roads could be constructed using gravel dumped directly by the trucks and spread by a grader, although the width and thickness of the gravel roadbed required would be dependent on the size and loaded weight of the gravel trucks used to deliver the gravel.

Gravel spreaders attached to the gravel delivery trucks, together with "dressing" by a lightweight grader, would be capable of effectively distributing the gravel up to 250 feet on either side of an access road. Thus, gravel access roads would need to be constructed every 500 feet across the area to be graveled, or approximately ten miles of access road would need to be constructed for each square mile of playa surface graveled. Because each truck applying gravel to the surface of the playa would be the same truck delivering gravel to the playa, it is assumed that to continue to the application site, wait in line, apply the gravel, and return to the edge of the playa would add only one hour to the cycle time for each delivery. This would slightly increase the number of haul trucks required for the deliveries and application, and would slightly increase the fuel usage. One grader operator and helper per shift would also be required.

Gravel could be also be placed on the Owens Lake playa by a conveyor/stacker system. If the conveyor/stacker system is fed by gravel delivered by truck, the gravel would be loaded into a hopper or feeder from a 24- to 48-hour stockpile by a front-end loader. If the conveyor/stacker system is distributing gravel delivered by conveyor from the extraction area to the playa, the gravel application system would simply be a continuation of the gravel transportation system, which would avoid any additional loading, unloading or handling. "Fixed" conveyors would move the gravel across the playa surface to the general vicinity of the application area. At this point, the gravel would be dropped onto a "movable," or "grasshopper," conveyor system, which shortens or lengthens as it is pulled or pushed across the application area. Actual distribution of gravel across the playa surface is accomplished by a radial or linear stacker or similar device, assisted by a low ground-pressure bulldozer or grader.

Radial stackers deposit gravel off the end of the stacker in a semi-circular pattern with a radius of approximately 150-175 feet while being moved back and forth in arcs by small, tracked "feet." A radial stacker would initially be positioned at the far end of a playa application area and fed gravel by the "grasshopper" conveyor. As each arc is completed, the radial stacker would be pulled back by a tractor, slightly shortening the "grasshopper" conveyor, and another arc would begin. A low ground-pressure bulldozer or grader would smooth and distribute the gravel after it is discharged by the radial stacker. When the radial stacker is contracted as far as the "grasshopper" system will allow, the tractor moves the system over and back out to the far end of the application area, and the process is repeated. Linear stackers can operate in a similar manner, although because they may be as long as 1,500 feet they swing around a "fixed" point and deliver gravel off either side of the conveyor at right angles to the arc, thus covering the entire length of the conveyor, or a one-half mile circle, in one pass. Small tracked "feet" move the conveyor through the arc. Following the completion of a full circle or arc, the linear stacker is disassembled and relocated to a new "fixed" point to begin the process again. Alternatively, linear stackers can move linearly along a fixed conveyor, delivering gravel out to the full length of the linear stacker along the entire length of the conveyor. Upon reaching the end of the conveyor, the linear stacker can be disassembled, moved to the other side of the fixed conveyor, and apply gravel back along the entire length of the fixed conveyor. In this manner, a 1,500-foot long linear stacker can apply gravel to a 3,000-foot wide strip along the entire length of a fixed conveyor.

Application activities would likely be conducted 24 hours per day, seven days per week. Peak electrical power requirements for either conveyor/stacker system is estimated at approximately 110 kW (150 horsepower) per mile of conveyor/stacker to deliver up to 400 cubic yards of gravel per hour. One bulldozer operator and one tractor operator per shift would also be required. Few access roads would need to be constructed on the playa surface for construction of the gravel blanket because movement of the conveyors, stackers, tractor and bulldozer should not need access roads. The possible exception is that disassembly and fabrication of the linear stacker between locations may require the construction of an access road. This would require approximately two miles of access roads per square mile of gravel placed on the playa. The noise levels created by the conveyors, radial stackers and grader are estimated not to exceed 85 dBA at a distance of 25 feet. The fixed conveyors would be constructed approximately four feet above ground, and the stackers would be 10-15 feet off the ground, at their highest point.

Operation and Maintenance Activities: Once the gravel cover has been applied to the playa, limited maintenance would be required to preserve the gravel blanket. The gravel would be visually monitored weekly to ensure that the gravel blanket was not filled with sand or dust, or had not been inundated or washed-out from flooding. If any of these conditions were observed over a substantial area, additional gravel would be transported to the playa via truck (unless the conveyor system was still in place and operational) and applied to the playa surface via truck and/or low ground-pressure bulldozer or grader. Operation and maintenance staffing requirements are estimated to be one FTEE per five square miles of gravel and an ongoing maintenance amount of gravel of 3,200 cubic yards per square mile per year.

2–3.1.10 Mandatory Elements of the Gravel Cover Control Measure

Areas C and E as shown in Figure 2.19 shall be covered to a depth of at least four inches with gravel clasts at least ⅜ inches in size. Where necessary to support the gravel blanket, it shall be placed over a permanent permeable geotextile fabric. The gravel shall have resistence to leaching and erosion. It shall be no more toxic than the gravel from the Keeler fan site analyzed for the EIR. It shall also be comparable in coloration to the lake bed soils. To protect the control measure from natural flooding, the City shall incorporate drains and channels in the control measure areas adequate to divert the flood waters away from the graveled areas and into the Owens Lake brine pool. The drains and channels shall be designed to incorporate features such as desiltation/retention basins adequate to capture the alluvial materials carried by the flood waters and to avoid greater than normal deposition of this material into the Owens Lake brine pool. The gravel placement design and implementation shall adequately protect the graveled areas from the deposition of wind- and water-borne soil. The City will apply best available control measures (BACM) and New Source Performance Standard (NSPS) emission limits to its gravel mining and transportation activities occurring in the District's geographic boundaries as required by the District in the City's District-issued Permit to Construct and Permit to Operate.

2–3.1.11 Other Mandatory Project Elements

The City will apply best available control measures (BACM) to control air emissions from its construction/implementation activities occurring in the District's geographic boundaries as required by the District in the City's District-issued Permit to Construct and Permit to Operate. In the construction and implementation of control measures, the City shall either avoid disturbing during the breeding season for each of the following bird species: (a) the nesting habitat (namely, shadscale scrub) of the Le Conte's thresher and loggerhead shrike during the breeding season for those birds; (b) the nesting habitat (namely, transmontane alkaline meadow) of the northern harrier; and (c) the nesting habitat (namely, the Owens Lake playa) of the western snowy plover. As an alternative, the City may elect, during the breeding season for those birds, to take adequate steps to identify and avoid disturbing breeding individuals of those species. The City's construction and implementation activities will comply with Mitigation Measures 5-6.1a and 5-6.1b set forth in the EIR relating to protection of prehistoric resources, and Mitigation Measure 5-4.3 relating to protection of sensitive plant species.

2–3.2 Proposed Control Measure Configuration

The Proposed Project will use the three control measures discussed above (shallow flooding, managed vegetation and gravel) to control PM_{10} emissions (Figure 2.19). The project requires, at most, the use of 51,000 acre-feet per year (ac-ft/yr) of water. This amount of water may decrease over time as improved water use techniques are developed and as the lake bed becomes vegetated. The site plan for the Proposed Project illustrates the location of dust control measures.

As stated above, the water for the project is presumably supplied from the Los Angeles Aqueduct. This alternative would use approximately the amount of water that analysis indicates could be supplied from the Los Angeles Aqueduct without causing significant impacts or water shortages to the City of Los Angeles, or significant indirect impacts to any other area. The amount of 51,000 ac-ft/yr represents approximately thirteen percent of the water that the LADWP exports to the City of Los Angeles.

2–3.2.1 Control Measure Detail

Shallow Flooding: An estimated maximum of 33,600 ac-ft/yr of water will be used for shallow flooding on approximately 8,395 acres of emissive lake bed (the annual amount of water required or "duty" = 4 ac-ft/ac/yr). Shallow flooding will be sited principally in sand-dominated areas west of the Owens River delta (Area A, Figures 2.19 and 2.20), between Keeler and Swansea (Area B, Figures 2.19 and 2.21) and a small area at the Dirty Socks dunes (Area F, Figures 2.19 and 2.24). Shallow flooding has been tested on sandy soils and has been determined to be very effective (Hardebeck, 1996). The design of the measure shall include provisions for recirculating drainage water, as this will allow for improved water use efficiencies and a decrease in the total amount of water required to control PM_{10} emissions.

The Owens Delta flooding area (Area A, Figure 2.20) will be approximately 1,210 acres in size and will be located on the west side of the Owens River delta. If the Los Angeles Aqueduct is used as the source of water for the project, the water would be delivered to this area along its north edge from an Aqueduct transmission main as it heads across the lake bed toward the east-side control areas. Water will flow south out of an outlet line approximately 7,000 feet long. The south and east boundaries of this area will have berms to prevent flows into the brine pool. A low-head pump will be located in the south east corner of the control area to allow excess water to be returned to the upper outlets.

The Keeler/Swansea flooding area (Area B, Figure 2.21) will be approximately 6,960 acres in size and will be located along the northeast historic shoreline between Swansea and Keeler. The area is about 5½ miles long and 2½ miles wide. Water would be delivered to this shallow flood area via two 30,00-foot long outlet lines. The use of two outlet lines will allow flows to be adjusted to this large area so that only enough water would be applied to keep the site wet and excess runoff would be minimized. A containment berm will be constructed along the lower (west) edge of Area B. This will prevent flow into the brine pool and will allow water that does flow to the lower edge to be collected and pumped back into the outlet system.

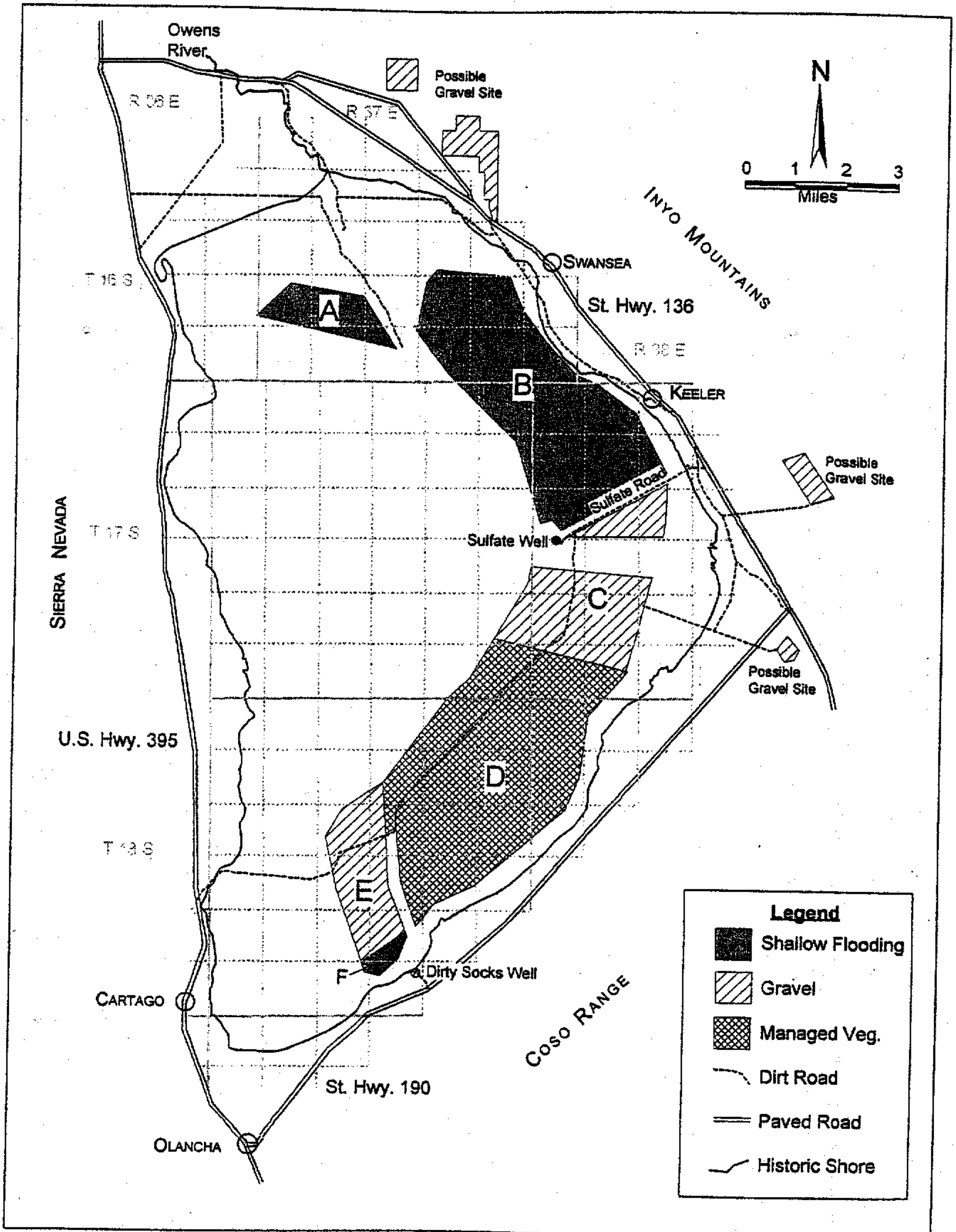


Figure 2.19: Proposed project - location of proposed control measures.

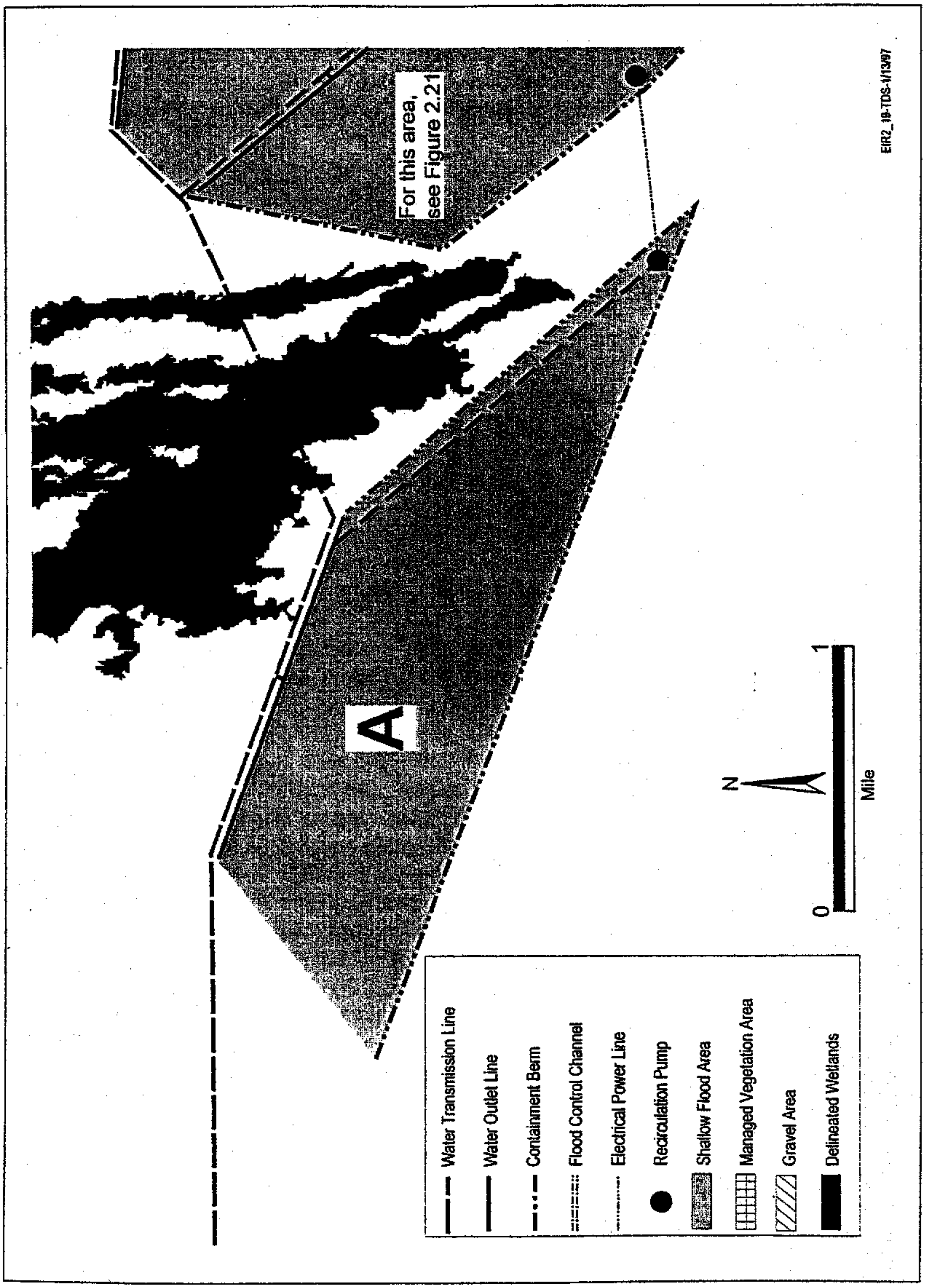


Figure 2.20: Proposed Project - delta flood area (Area A).

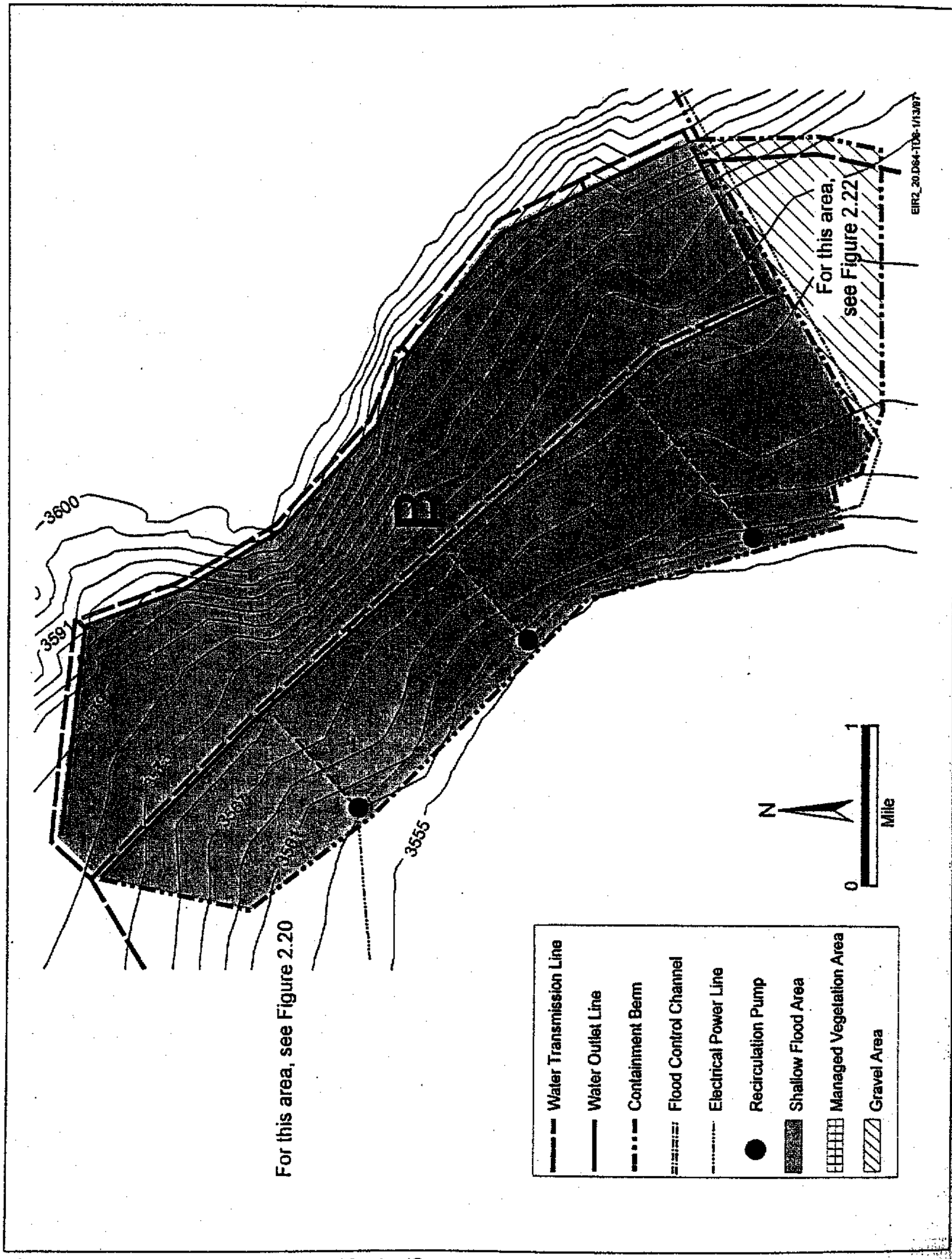


Figure 2.21: Proposed Project - Keeler/Swansea flood area (Area B).

The southern portion of the Keeler/Swansea flood area (Area B, Figures 2.19 and 2.21) is located on the playa on what is described in Section 3–1.3.3 as the Keeler transition zone. This transition zone marks the boundary between the deep sands of the northeast sand sheet and the crusted clays along the southern portion of the playa. Although this soil transition zone contains some fractured clay-dominated soils close to the surface, in general, the transition zone is composed of surface sand deposits that are several inches up to two feet thick. Data from shallow piezometers in the transition zone indicate that the shallow groundwater is typically within 2-4 feet of the surface. Therefore, it is anticipated that the conditions for shallow flooding across this zone are not significantly different from those tested on massive sand sheets to the north. This conclusion is supported by the presence of three main spring areas (Black Sand Spring, Horse Pasture Spring and Keeler Spring) that discharge water to the surface near the historic shoreline and flow across the Keeler transition zone often extending for a considerable distance out onto the playa.

The Dirty Socks flood area (Area F, Figure 2.24) will be about 225 acres in size and is located north of the Dirty Socks Well. Water will be outlet onto this area through a 6,000-foot pipeline. A containment berm will surround this area and, as with Areas A and B, water recirculation facilities will be provided. This control area will surround the existing Dirty Socks dune that has formed since the lake dried. Surrounding this dune with wet soil will prevent south winds from blowing dune sands into the Dirty Socks gravel area located directly to the north.

Managed vegetation: There are approximately 11,400 acres of clay-dominated soils that are appropriate for implementing managed vegetation. These soils begin in the approximate vicinity of the Sulfate Road, and extend southerly to just north of the Dirty Socks Well (Areas C and D, Figures 2.19, 2.23 and 2.24). 8,700 acres of this area is proposed for managed vegetation (Area D). The remainder is slated for gravel coverage (Area C). Area D is estimated to use a maximum of 17,400 ac-ft/yr (duty = 2 ac-ft/ac/yr).

The clay soils in this area are appropriate for the construction of earthen delivery channels, berms, and open drains that comprise this measure's infrastructure. In addition, the texture and fractured structure of the clay soil makes it well suited for water distribution, leaching, and plant growth. High volumes of water will be delivered over short periods of time to flat confined fields that have been ripped or disced to a depth of at least 24 inches to facilitate infiltration and leaching. Water will travel rapidly over the clay surface to spread in a shallow, even fashion, and will not be immediately lost to deep percolation as would be the case in the coarse sandy soils elsewhere on the playa. Salty water resulting from the leaching action is rapidly transmitted through the soil profile by the network of existing fractures, allowing for effective drain water collection. Finally, the fine clay particles have a very high pore volume (approximately 50%) and therefore retain ample water for a long period of time that can be used by plants between irrigation events (Stradling, 1997 and Ayars, 1997).

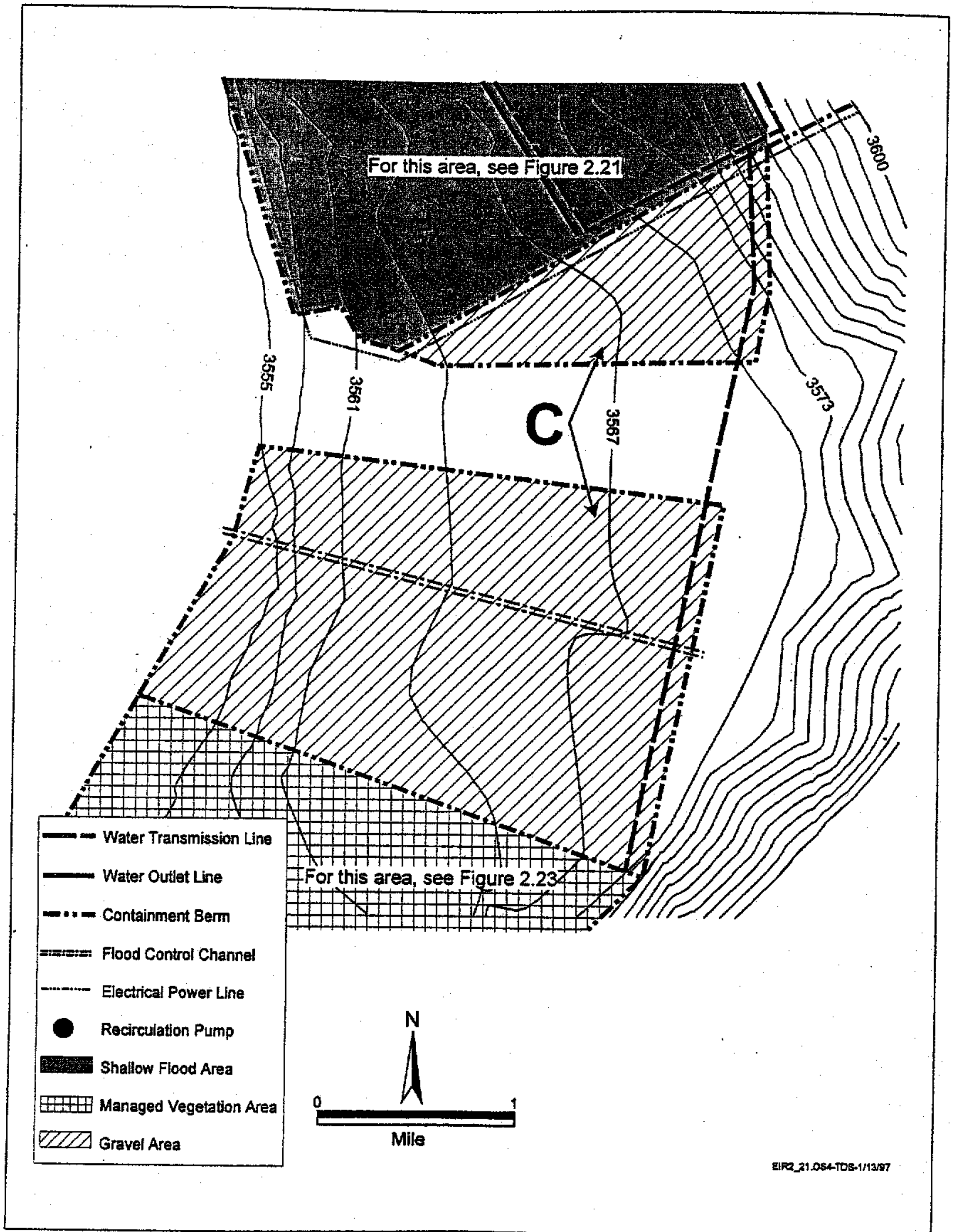


Figure 2.22: Proposed Project - east gravel area (Area C).

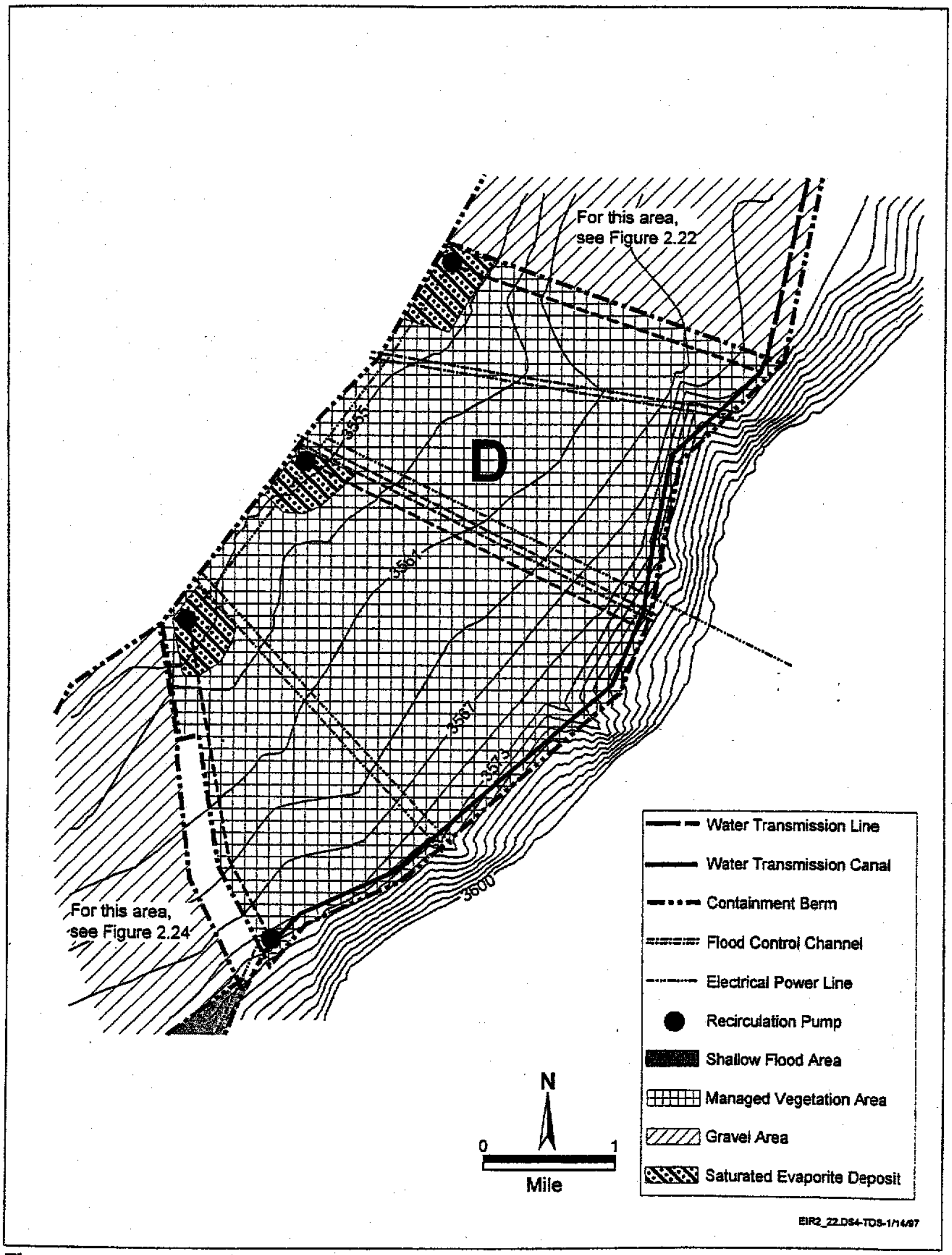


Figure 2.23: Proposed Project - Coso vegetation area (Area D).

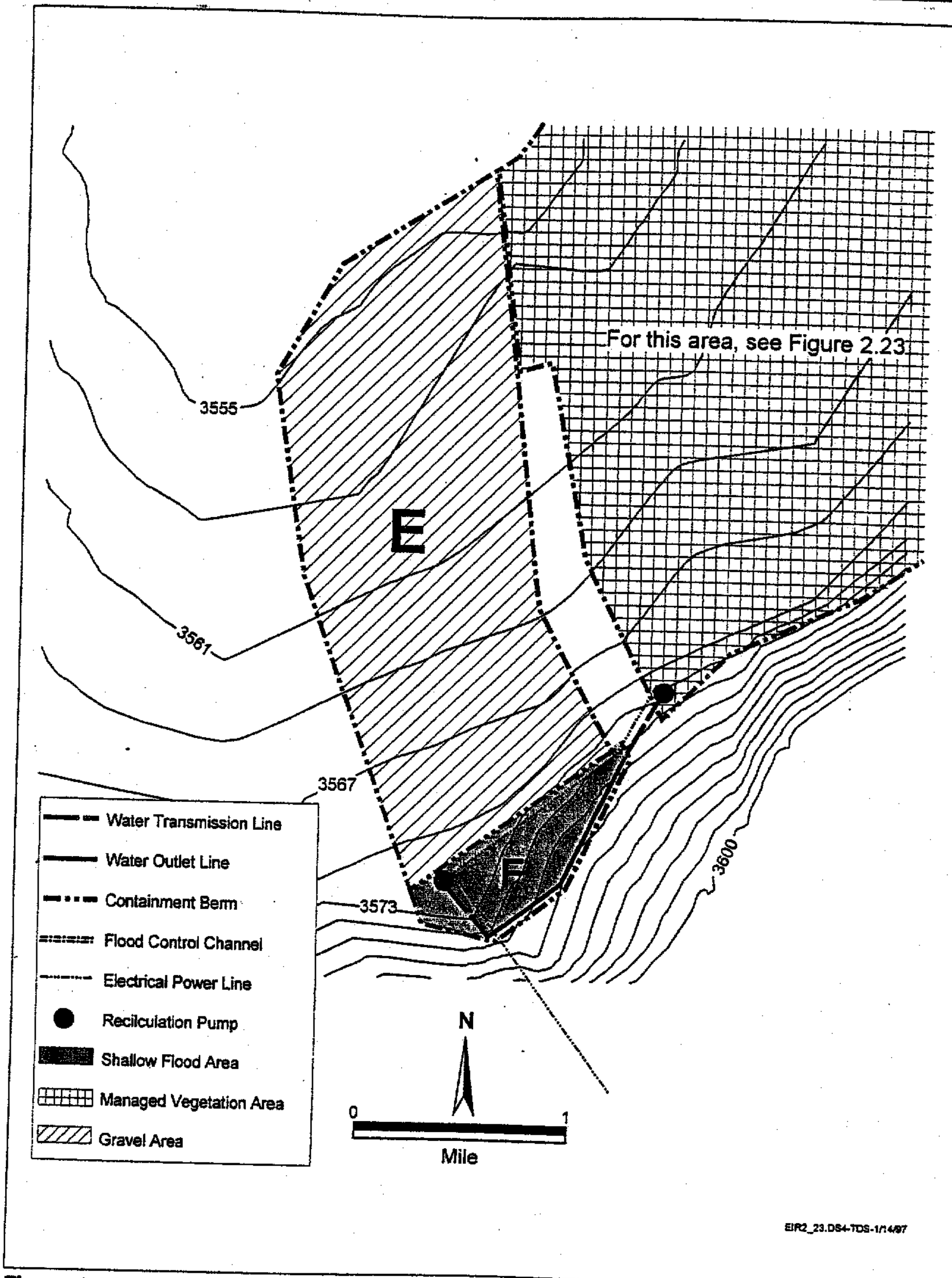


Figure 2.24: Proposed Project - Dirty Socks gravel and flood areas (Areas E and F).

As with the shallow flooding control measure, efforts to improve water use efficiencies will continue. Increased understanding of patterns of consumptive use of the plants being cultivated, and of the minimum cover required to stabilize the soil surface will allow for highly customized irrigation schedules and duties. As soil leaching progresses with time, drain water recovered from the fields may be suitable for recycling onto the fields for continued irrigation, resulting in lower overall water use. Effort will also be made to introduce appropriate drought-tolerant plants, which will allow the measure to be successfully operated with the minimum amount of water.

Because this area of the lake bed is subject to frequent, and often large, storm water flows from the Coso Range, the managed vegetation control area will be protected along its upper edge with a storm water diversion berm and flood waters will be directed into flood control channels that will travel across the site toward the brine pool. The lower edge of the area will also have a containment berm to prevent flows into the brine pool and to protect the site from high lake levels.

Gravel: Gravel will be used to control the remaining 5,305 acres of emissive area. The gravel will be used in two areas dominated by transition silty clay to silty sand soils in the central portion of the emissive area (Area C, Figures 2.19 and 2.22) and at the very south end of the dust area north of the Dirty Socks well (Area E, Figures 2.19, and 2.24).

If the entire 5,305 acres is covered with a 4-inch layer of greater than ⅜-inch gravel, approximately 2.8 million cubic yards of gravel will be required. If a gravel production/transportation/spreading rate of 200-400 cubic yards per hour is assumed, it would take between one and two years to install 5,305 acres of gravel cover. Different installation rates will take proportionally different installation times.

The two gravel areas will be surrounded by berms and flood control channels to protect the gravel from flash floods, high brine pool levels, spring flows and adjacent water-based control measures. Gravel is proposed to be the final measure implemented. The 5,305 acres of gravel would be the maximum area proposed under the scope of this EIR.

Control Measure Summary: Table 2.1 summarizes the size, the annual water duty and the annual water volume for each of the control areas.

Table 2.1: Control Measure Summary of the Proposed Project.

Control Area	Area (acres)	Duty (ft/yr)	Volume (ac-ft/yr)
Delta Flood	1,210	4	4,840
Keeler/Swansea Flood	6,960	4	27,840
East Gravel	3,365	0	0
Coso Vegetation	8,700	2	17,400
Dirty Socks Gravel	1,940	0	0
Dirty Socks Flood	225	4	900
Totals:	22,400		50,980

2–3.2.2 Mitigation and Monitoring

The control measures and related infrastructure elements have been sited in an effort to avoid adverse impacts to sensitive areas and resources. All existing wetland sites, including those in the delta region and wetlands on the north, east, and south perimeters of the playa, will be avoided except for one predicted road/pipeline crossing and one predicted powerline crossing of the lower portion of the Owens River delta. All infrastructure elements are sufficiently flexible in their location to allow for avoidance as a mitigation measure for potential impacts to sensitive habitats and resources that would be identified by survey. In addition, all construction operations will be scheduled to minimize disturbances to sensitive wildlife and their use of lake-area habitat on a seasonal basis.

At the time the District Board approves the project, it will adopt a mitigation measure monitoring program. Baseline data have already been collected for both shallow and deep groundwater characteristics, as well as for wildlife and vegetation. A complete wetland delineation has been completed for the project area, and three years of data have been collected from selected indicator sites in wetland areas around the playa that detail characteristics of shallow groundwater, soils, and vegetation. These data will be used in periodic reviews to determine whether required mitigation measures are being properly implemented.

2–3.2.3 Project Schedule and Phasing

The Proposed Project is projected to be implemented in phases, on an area-by-area basis, over a five-year period. The order of implementation within each area will generally be as follows: roads, electrical lines, water supply pipelines, flood control channels, containment and diversion berms, flood irrigation, vegetation and gravel. There are two reasons for this order: (a) it allows most of the support infrastructure construction to occur before access is restricted by the wet soils caused by the water-based measures; and (b) it provides the opportunity to observe the actual coverage and effectiveness of the proposed water-based measures, and to maximize their extent, before the graveled areas are installed. Because gravel is the most costly measure to install, every attempt should be made to minimize its extent, and therefore, it should be the last measure to be implemented. However, if the gravel is protected from wind- and water-borne soil deposits, it can be installed at any time or can replace water-based measures, if necessary.

The three control measures, flood irrigation, managed vegetation and gravel, will also each be installed in phases. The first phase of each measure will consist of a moderately large segment of the total, approximately 1,200 acres, that will allow construction and operation techniques to be refined. Subsequent phases can then take advantage of this knowledge to lower the costs associated with these later phases.

Shallow Flooding: Phasing for the shallow flooding would take place over four years. During the first year the infrastructure for Area A and approximately the northern ⅓ of Area B will be constructed. Shallow flooding of Area A can begin after the first year. In the second year the water transmission lines will be extended to the north end of the Managed Vegetation area (Area D) and the remaining infrastructure in Area B will be completed. After the second year, water can begin to be applied to Area B. No shallow flood construction will take place in the third year. In the fourth year Area F will be constructed and will begin operation.

Managed Vegetation: Phasing for the managed vegetation control measure is expected to take place over a period of four years. During the first year no managed vegetation construction will take place, as the infrastructure necessary to deliver water to the site will be under construction to the north. During the second year, 1,200 acres will be developed. The third year will implement an additional 2,400 acres, and the remaining 5,100 acres will be constructed during year four. This phased approach will allow for the maximum opportunity to expand knowledge regarding construction techniques, material limitations, water use, and plant introduction techniques and husbandry.

Gravel: If all the gravel comes from either the basalt site or the Keeler Fan site, gravel construction will take five years to implement. No work will be performed in the first 1½ years. During the second year the support infrastructure, roads, containment berms and flood control will be constructed. Gravel placement will take place during the third and fourth years.

If all the gravel comes from the Dolomite site, gravel placement would take five years. Because the gravel can be hauled past Keeler only Monday through Friday during daylight hours, the graveling rate will be lower than at the other two sites. Therefore, during the first year support infrastructure will be constructed and then gravel will be hauled for four years.

2–3.2.4 Cost and Employment

The comparative preliminary cost estimate for the construction of the Proposed Project is $91 million. The comparative preliminary cost estimate for annual operation and maintenance is $26 million. These estimates assume that the water supplied from the Los Angeles Aqueduct is replaced by the City with purchases from the Metropolitan Water District at a cost of $450 per acre-foot. Using the construction and annual cost estimates, the 25-year annualized cost is $38 million. It is estimated that the Proposed Project will create between 84 and 91 jobs during construction and fourteen long-term jobs for operation and maintenance of the control measures (GBUAPCD, 1997b).

3–2.3.4 Hydrologic Storage in the Basin

3–2.3.4.1 Owens Lake

Historic Fluctuations and Modern Brine Pool: During the Pleistocene, Owens Lake on occasion spilled over Haiwee Pass and flowed south to fill Searles, China, Panamint, and Manly Lakes (Benson *et al.*, 1990). Smith and Street-Perrott (1983) estimated that the last overflow of Owens Lake occurred 2,000 years ago. Since that time, Owens Lake has been the terminus of the Owens River. Their estimate is based on the salt accumulation found on the playa and the time required to deposit those salts from the Owens River. Prominent historic shorelines near Owens Lake playa are present at an elevation of 3,880 feet.

Written records of the elevation of Owens Lake begin in 1872. Lee's (1915) study indicates that the elevation of the lake between 1872 and 1878 was approximately 3,597 feet covering an area of nearly 72,000 acres. After this period, Owens Lake elevation began to drop in response to diversions for agriculture. Heavy precipitation in the late 1880's and early 1890's failed to bring the level of the lake up as surface-water diversions for agriculture increased. Between 1895 and 1905, a severe drought lowered the lake level to an elevation of 3,565 feet, which covered an area of 42,500 acres. Prior to the diversion of the Owens River to the City of Los Angeles, the lake had rebounded to an elevation of 3,579 feet covering an area of approximately 60,539 acres (Lee, 1915). Upon completion of the Los Angeles Aqueduct and diversion of the Owens River, Owens Lake essentially dried up by 1924.

Since the desiccation of Owens Lake, a brine pool of varying size has existed in the topographically lowest portion of the playa. The size of this pool has varied from 0 to approximately 30,000 acres (3,550 feet to 3,559 feet in elevation, respectively) depending on local precipitation and aqueduct releases. Figure 3.15 shows the changes in lake elevation between 1872 and 1985.

Elevation-Area-Volume Curves: Throughout the recorded history of the elevation of Owens Lake, data have been collected from staff gages on the west shore of the lake. The recorded elevations were then converted to lake area and volume by curves developed by Lee (1915) and later by curves developed by Blevens *et al.* (1976). New elevation-area-volume curves have been generated that incorporate data from several sources. The sources include measurements from the piezometer network installed by the District, GPS measurements, Owens Lake sounding data collected by Lee, a topographic contour, and satellite imagery. All of the data were brought into the ARC/Info system and contoured (see Figure 3.4), then used to develop the new elevation-area-volume curves as shown in Figure 3.16.

3–2.3.4.2 Groundwater Storage

The volume of groundwater stored within the Owens Lake basin (see Table 3.13) was calculated by dividing the water-bearing sediments into four separate domains to a total depth of 984 feet below the playa elevation. The four water-bearing domains are comprised of the aquifer units, the confining units (aquitards), the alluvial sediments, and the transition-zone sediments (Figure 3.12). The transition-zone sediments are conceptualized to exist between the alluvial fans, and the lake sediments. The calculation assumed that the Owens Lake playa is flat with a constant elevation of

Landmark No. 752. A small complex of historic buildings is located at the old site of Swansea, which is now part of a private residence. These buildings were constructed primarily of local rough-dressed rock, although one exhibits clay-chinked style masonry.

The Cerro Gordo Landing was built in 1873 at the future site of Keeler to accommodate steamboat travel to and from the east and west sides of the lake (Krautter, 1959). In 1879, the newly incorporated Owens Lake Mining and Milling Company sent Captain Julius M. Keeler, a Civil War veteran, to Owens Valley to oversee its operations on the eastern shore of Owens Lake. He designed the town of Hawley in 1880, which became known as Keeler in 1882 (Sowaal, 1985; Krautter, 1959). At its population peak, Keeler, which had been designed to occupy 42 blocks, had 7,500 permanent residents.

In 1921, Keeler had three stores, a small school house (built in 1897), blocks of residences, the Carson & Colorado (C&C) Railroad depot, the Cerro Gordo Mill, and the Sierra Talc Company Mill (O'Connell, 1995). Water from springs and from an artesian well along the lakeshore at Keeler was sold for 10 cents a gallon. Keeler also supported three hotels, The Mates, The Keeler, and The Terminal, all of which were later destroyed by fire. The town also had boarding houses, saloons, and a theater concentrated in a district known as Chinatown. Lo Yo owned and operated a Chinese laundry and, reportedly, a gambling house and opium den that were reached via a concealed tunnel from the laundry. Many old mining towns have stories of such concealed tunnels. However, no such tunnel has yet been identified by archaeological excavation (Russell, 1991). Several 19th-century buildings associated with the C & C Railroad are still standing at Keeler. In addition, abandoned boxcars are situated near the now-defunct railroad grade. These structures, as well as a few railroad cars, have been converted into residences.

3–6.3.3.2 Transportation

Mule Teams: In 1873, Remi Nadeau secured backing from Belshaw and Beaudry to start the Cerro Gordo Freighting Company with a three-year contract to transport bullion (Nadeau, 1965). Eighty wagons were built, 56 of which were in regular service. Each wagon held nearly as much cargo as a narrow gauge boxcar. In 1881, the Cerro Gordo Freighting Company dissolved, and Remi Nadeau moved to Los Angeles to enter the hotel business (Chalfant, 1933).

Steamboats: In 1872, D. H. Ferguson and James Brady, superintendent of the smelting company [illegible] Swansea, built the steamboat the *Bessie Brady* to haul bullion across Owens Lake (Nadeau, 196[illegible] Sowaal, 1985). They built a 300-foot landing at Swansea, as well as a rail track on which horse-drawn cars hauled bullion to the landing. John Daneri, a Lone Pine businessman, built Daneri's Landing, to accommodate the steamer at an area that became known as Cartago (Likes and [illegible] 1975). The *Bessie Brady* made round trips daily from Swansea to Daneri's Landing (see Figure [illegible]) carrying bullion south and supplies for mining communities north (Chalfant, 1933).

Direct and indirect impacts were examined using a 20-year simulation analysis. Predicted changes in water deliveries were estimated from results of the Los Angeles Aqueduct Monthly Program (LAAMP) over a 20-year projection period (1996-2015). This projection period was constructed by randomly selecting 20 years out of the 50-year historical hydrological record. The number of dry, normal, and wet years was selected proportionate to their percentage of occurrences in the 50-year period. Monthly projections of water delivered from Haiwee Reservoir to the Los Angeles Aqueduct were used to construct annual projections over the 20-year period for the base case or "no aqueduct withdrawal" condition.

The same 20 years of Los Angeles Aqueduct water deliveries used to conduct the water supply impact analysis for the Mono Basin Water Rights EIR were used to conduct the water supply impact analysis for the Owens Lake DEIR. The primary difference is that the State Water Resources Control Board's Mono Basin Decision 1631 represents the base case condition for the Owens Lake DEIR analysis. In other words, Los Angeles aqueduct water deliveries associated with Mono Basin Decision 1631 represent the base case condition for the Owens Lake project. In 1997, LADWP is scheduled to begin diversions from the Mono Basin because Mono Lake has reached an interim elevation specified in Decision 1631.

For the Proposed Project, the model assumes that 50,980 ac-ft of water is removed from the aqueduct to meet the specific water requirements for the Proposed Project. The water supply cost impacts are shown in Table 4.7.

The simulation model contains water demand projections and water supply sources in the LADWP service area for the next 20 years (1996-2015). Water supply sources are selected to meet demand based on the procedures described below.

Demand Projections: The demand projections used for this analysis incorporate the effects of water conservation, population density, commercial and industrial growth, pricing, and other factors that affect water use (LADWP, 1995). Figure 4.18 shows LADWP's projected water demand from 1996 through 2005. LADWP's water demand is expected to increase from 636,700 ac-ft in 1996 to 749,900 ac-ft in 2015, an increase of eighteen percent (0.82 percent per year).

For the analysis of direct impacts, two model runs were conducted. One run assumed no growth in LADWP's projected water demand over the 20-year simulation period. The second run assumed LADWP's projected water demand to be equal to that shown in Figure 4.18.

CHAPTER SEVEN

PROJECT ALTERNATIVES

7 PROJECT ALTERNATIVES

This chapter describes the range of PM_{10} control measures that were considered for implementation on Owens Lake. It discusses the reasons why some candidate measures were eliminated from further consideration. It presents eight alternatives that were made up of a combination of the candidate control measures and it discusses the "No Project" alternative. The significant impacts of the alternatives are considered and compared with the Proposed Project and the environmentally superior alternative is discussed.

7–1 CONTROL MEASURES

7–1.1 Introduction

The control measure development, selection and implementation process was described in Section 2–3.1.1. In addition, this process has also been described in the *Project Alternatives Analysis* (PAA) prepared by the District (GBUAPCD, 1996d) which resulted in the selection of the Proposed Project and it was described in the *Best Available Control Measures State Implementation Plan* (BACM SIP) (GBUAPCD, 1994). The above referenced PAA contains significant additional details regarding alternative control measures and alternative control scenarios.

7–1.2 Control Measures Considered by the Project Alternatives

Each of the Project Alternatives includes a mix of control measures proposed in different application scenarios. In addition to the three control measures evaluated as part of the Proposed Project (shallow flooding, managed vegetation and gravel), other control measures were also considered technically feasible and evaluated as part, or all, of the mix of one or more of the Project Alternatives. The other control measures included:

Tilling: Wind erosion can be controlled by reducing wind velocity at the soil surface by roughening it with tillage implements, creating large ridges and furrows and by leaving non-erodible clods, with high threshold velocities on the surface. For dust control purposes, tilling works most effectively in clay or silty clay soils. In these soils, clod stability is increased, reducing the susceptibility to abrasion from wind-blown soil particles and breakdown from rain. Large areas of clay soil can be controlled using tilling with only minimal infrastructure needed for periodic wetting of the furrows, as necessary, prior to re-tilling. It is not anticipated that tilling will preclude the use of any other control measure in the future. Natural precipitation or other re-wetting of the tilled area should level the lake bed surface and return it to its existing condition.

Salt Flats: The sediments that form the Owens Lake playa contain large quantities of chloride, sulfate, and carbonate salts. Water flowing in or across these sediments dissolve these salts and leach them out of the sediments. When these salt-rich (saline) waters evaporate, the salts precipitate and a salt crust forms on the surface of the playa. Salt-crusted surfaces such as these exist near the Owens Lake brine pool where natural salt evaporite deposits formed as the Owens Lake dried in the 1920's. An evaporite salt crust can be quite durable and significantly reduce the emission of PM_{10} from the Owens Lake playa if it is of the proper chemical composition and is of sufficient thickness (typically a minimum of two inches). Salt flats can work effectively on essentially any type of flat soil surface.

Salt flat formation on the Owens Lake playa would be implemented as a "tail-end" measure in areas down gradient from other water-based control measures and up gradient from the Owens Lake brine pool. Thus salt flats would act to both control PM_{10} emissions and prevent water used for other control measures from entering the Owens Lake brine pool and diluting or flooding these resources

Unconfined Deep Flooding: For this control measure, all the surface water from the Owens River that naturally flowed into Owens Lake and is now diverted by the City of Los Angeles would be restored to the lake until the water level was sufficient to cover the PM_{10} source areas. This water would be diverted from the aqueduct to the lake via a pipeline. The pipeline would run along the east side of the dust emitting area. Water would be outlet from this pipe in a manner similar to unconfined shallow flooding and would flow across the dust producing area toward the brine pool at the lake's low point. As the lake level rose, it would inundate dust source areas. In order to control the identified source areas, the lake level would have to stand at 3,584 feet AMSL (about 100 square miles). The City could export excess water, if any, after the 3,584-feet AMSL elevation was achieved.

On average, about 320,000 ac-ft/yr of water that naturally flowed to Owens Lake is diverted to Los Angeles. Assuming an evaporation rate of 5.0 ft/yr and a lake area of 100 square miles, 320,000 ac-ft/yr would be required to maintain the required lake elevation of 3,584 feet AMSL. Using a mathematical model prepared for the District by the Desert Research Institute, it was calculated that it would take approximately 25 years for Owens Lake to reach an area of 100 square miles if all the available water (an average of 320,000 ac-ft/yr) were used.

Sand Fences: Protecting existing surfaces from wind erosion and sand abrasion will reduce PM_{10} emissions from the Owens Lake playa. Sand and sand-sized particles of broken crust blowing across the intact crusts break the crusts down and release PM_{10} particles. Once the crust is gone, loose fine soil and salt particles are exposed to the winds. Empty or partially-filled sand fences can reduce the production of PM_{10} from the lake bed surface by acting as: (a) barriers that reduce the wind speed at the surface to less than that needed to loft particles, (b) sand capture devices that protect the surface for a limited distance downwind of the fence from sand abrasion and (c) sand storage areas that can reduce the availability of abrasive materials. Sand fences can also be installed in combination with other control measures, such as preventing the infilling of gravel and the sand blasting of vegetation. Sand fences sufficiently protect downwind surfaces a distance of 7-10 times the height of the fence. No other control is required between fences. Fences that become filled to capacity with sand do not protect downwind surfaces, and can become contributing sand sources.

Tree Row Wind Breaks: On playa areas with deep sands and a shallow water table, rows of rapidly growing trees could be established to act as windbreaks that would function in the same way as sand fences. The deep sands leach readily to a salinity level low enough for the establishment of hybrid poplars, which are currently being grown in the Owens Valley on woodlots. Drainage would be required to permanently remove the salts from the rooting zone of the trees, and to prevent the incursion of salts into the rooting zone from the shallow water table.

Tree rows would be established between 100 to 250 feet apart in a direction perpendicular to the prevailing winds. The strips to be planted would be leached and irrigated using a buried drip irrigation system. Perforated pipe drains would be installed at intervals sufficient to remove the shallow water table to a depth necessary to accommodate the rooting depth of the trees. Drain water would be discharged from the area to salt flats using pumps. Trees would be planted when leaching has reduced soil salinity to a level tolerable to the trees, and irrigation would be continued at levels necessary to support rapid growth. Initial plantings would be at close intervals in order to stabilize the soil surface even before the trees attain their maximum height of approximately 40 feet. As the trees grow, irrigation to some rows could be discontinued if a less dense row spacing will attain the degree of dust control necessary.

7–1.3 Control Measures Evaluated but Eliminated from Further Consideration

Other potential PM_{10} control measures were considered by the District, but these measures were determined to be either ineffective or could not be reasonably implemented to meet the goals and objectives of the Attainment SIP. Consequently they are not included in any of the considered alternatives. The following control measures were systematically evaluated and rejected during analysis for the preparation of the 1994 BACM SIP and/or the 1996 PAA.

7–1.3.1 Surface Compaction

In November 1988, the District attempted to control the formation of emissive efflorescent salt crust and create a more competent surface crust by compacting the lake bed surface. Heavy construction rollers were used to compact both wet and dry surface soils on a test plot. The test results indicated that the unavoidable changes in soil temperature and moisture conditions cause crust heaving and cracking which causes the compacted crust to soon lose any protective capabilities.

7–1.3.2 Chemical Salt Modification

In 1988 and 1989, the District tested three chemicals that were thought to have the potential to modify the lake bed salts and produce a more durable surface crust. Magnesium chloride, calcium chloride, and CMA (an acetate salt) were applied at three locations on the lake bed. There was an initial application in November 1988 and a reapplication in March of 1989. The treated surfaces were then monitored against control plots at each location. Although there may have been some minor increase in surface stability on the treated sites, there was no evidence that chemicals would be a useful large-scale, long-term dust control measure.

7–1.3.3 Chemical Stabilizers

Since 1983, a number of chemical stabilizers, or dust palliatives, have been tested on Owens Lake. The chemicals have been applied at various lake bed locations on a variety of surface types with a number of application rates. The treated surfaces were then monitored against control plots at the same location. Although there may have been some minor increase in surface stability on some of the treated sites, there is no evidence that chemicals would be a useful large-scale, long-term PM_{10} control measure. This is most likely due to the high soil salt levels and the dynamic nature of the natural soil crusts.

7–1.3.4 Sprinkler Systems

In 1990 and 1991 a test took place that involved the construction of a sprinkler system test site to wet the lake bed prior to predicted wind events in an attempt to reduce PM_{10} emissions. The test was conducted by Great Basin, the State Lands Commission and the Department of Water and Power. The site was approximately 250 acres in size and was located in the sand dominated north portion of the lake bed. Pumped groundwater was used for testing.

The test results indicated that in areas dominated by sandy soils, the sprinkling did not reliably decrease the amount of sand moving across the lake. It was observed that within hours of the water application that the surface dried to the point that sand could be blown by the wind. Since PM_{10} emissions in these areas are largely caused by saltating sand, the test concluded that for sand dominated areas, sprinkling cannot be relied upon to reduce PM_{10} emissions (Ono, 1996).

7–1.3.5 Lower Groundwater Table

Saint-Amand suggested that dust concentrations from Owens Lake could be reduced by lowering the shallow groundwater to a depth of ten feet or more beneath the playa surface. This suggestion results from the observation that, on other dry playas in the Basin and Range province, efflorescent salt crusts do not form where the depth from the surface to the groundwater table is greater than ten feet. The growth of salt crust on many areas of the Owens Lake playa has been observed to be an important factor in the production of dust.

Review of shallow groundwater data from Owens Lake shows that, during the period from the summer of 1993 through the present, the shallow groundwater table over large portions on the clay-dominated lake bed was in excess of 10-16 feet below the surface. Yet during this time period, these same areas developed extensive salt crusts and were in areas of active dust production. Unlike other playas, Owens Lake is a recently formed playa environment with strong artesian pressures and significant water recharge into the system. Thus, even with relatively deep groundwater levels, the soils maintain a high moisture content and salt growth at the surface continues. Given enough time (hundreds to thousands of years) Owens Lake may become similar to these other playas. However, under the current conditions, it is not feasible to reliably reduce PM_{10} emissions through lowering of the shallow groundwater.

7–1.3.6 Alternative Surface Protection Measures

It has been suggested that alternative materials such as discarded automobile tires, compressed trash, asphalt products, and similar waste materials could be used to simply cover the lake bed, which would prevent dust emissions. Although the effectiveness of these measures may initially be high, they are not locally available in sufficient quantities, transportation costs to bring them in from outside the local area would be high and their durability would be low. Gravel is both locally available in sufficient quantities, it is a natural material and it is far more durable than the suggested alternative materials. In addition, the State Lands Commission staff advised the District in 1991 that these measures were unsuitable (GBUAPCD, 1994a). This opinion was confirmed by the SLC Executive Officer (Hight, 1994). The District has not pursued testing of these measures.

7–1.3.7 Riparian Corridors

In September 1991, scientists at U.C. Davis proposed, among other measures, a series of sand dune corridors (a.k.a. riparian corridors) perpendicular to the prevailing winds "designed to cut the wind fetch into sections, each less than one mile across" (Focchini *et al.*,1991). The projected effectiveness of the measure was based upon their hypothesis that a one-mile wind fetch length is one of the five conditions essential to generate a dust storm (Kusko and Cahill, 1984). This condition came from observations at Owens Lake.

The basis for such a condition for dust-storm generation would be the "fetch effect", the observed increase of soil movement with distance downwind when all other factors (available erodible soil, wind velocity) are constant. The theoretical mechanism would be the "avalanching fetch effect" where one sand particle bounces and when it hits the ground releases two particles, and so on. Some distance (fetch length) would be required before sand movement built up sufficiently to destroy crusts and generate PM_{10}. Dune corridors would have the same effectiveness as sand fences in their immediate area. However, if a long fetch length is required to establish enough sand motion for PM_{10} production, it was hypothesized that corridors could protect crusts well beyond the immediate area, perhaps up to one mile.

This hypothesis was tested in several ways, including:

(1) Sand motion was measured by the District on the North Flood Irrigation Project for one year before flooding began (Hardebeck et .al., 1996). The avalanching fetch effect should show up as a steady increase in sand motion downwind along the fetch for those storms where the wind direction was lined up with the measuring devices. Instead, the amount of sand motion was related to where the measurement was made on the lake bed, and not position along the wind fetch.

(2) Sand motion was measured for the California Air Resources Board (CARB) on the south end of the lake (Cahill and Gillette, 1994). The conclusion was that for scales greater than 50 to 100 meters, the avalanching fetch effect was not very important. Sand flux was much more dependent on the local conditions of the lake bed material.

(3) U.C. Davis measured sand motion through an array of fences on the south end of Owens Lake (Cahill, et. al., 1995). Sand flux was completely reestablished within 100 meters of the end of the array.

These measurements show that any "fetch effect" on sand motion from the dune corridors will not extend more than about 100 meters and may not exist at all. Thus, the effectiveness of dune corridors is only local to the corridors and is similar to that of sand fences as described above.

There are two other difficulties with the dune corridor proposal. The first is that the dunes that form the corridors would have to be stabilized or they would themselves become sources of sand and therefore PM_{10}. Vegetation could be used to stabilize the dunes if the salt content could be sufficiently reduced. Man-made dunes existing on the Owens Lake playa at this time have a higher salt content in the rooting zone than the lake bed itself, since they are formed from the lake surface materials where evaporation concentrates the salts (Dahlgren, 1992). In four years (1988-1992) natural rainfall had not decreased salt levels at the rooting depth (4-10 inches) on the Keeler one-mile fence dune even to the levels of the surrounding lake bed. At the rooting depth (4-10 inches) Dahlgren measured salinities of 2½ to 10 times higher in the Keeler dune than on the surrounding playa and 1.5 times higher on the Westec Dunes than on the surrounding playa. Measurements made on the Davis dunes in May of 1994 showed rooting zone salinities slightly higher on the dunes than on the playa (Schiedlinger, 1995).

The second difficulty with the dune corridor proposal is that the vegetation would have to be watered in order to maintain sufficient cover to stabilize the sand in the dune. Natural rainfall, which amounts to approximately four inches/year on Owens Lake bed, would be sufficient to support only about a three percent cover of native shrubs, for example. (Groeneveld, 1994). Therefore, the vegetation would have to be irrigated on a regular basis in order to sustain sufficient cover to stabilize the dune. For saltbush, the amount of supplemental irrigation could approach three ac-ft of water per acre of dune surface per year to achieve 40 percent cover. (Groeneveld, 1994). For saltgrass, where cover effective for soil stabilization includes the standing dead biomass, the figure would be approximately 2.3 ac-ft of water per acre of dune surface per year (Groeneveld, 1994b).

Therefore, dune corridors, as distinct from sand fences, are not believed to be effective as a large scale PM_{10} control measure and this measure was eliminated from further detailed consideration.

7–1.3.8 Attainment Extension Under Section 188(e) of the Clean Air Act

In its response to the Notice of Preparation, the City of Los Angeles proposed that the District analyze, as an alternative to the Proposed Project, obtaining an extension of the federal attainment deadline. Under existing law, the State of California must submit a State Implementation Plan (SIP) in 1997 that demonstrates that the federal standard for PM_{10} particulates will be attained by December 31, 2001. Section 188(e) of the Clean Air Act authorizes the Administrator of federal EPA to grant an extension of the attainment deadline, for no more than five years, under certain circumstances described in Section 188(e). The preconditions to application for an extension include a demonstration that attainment by the 2001 deadline is impracticable, that all requirements and commitments in existing air quality plans for the area have been complied with, and that the air quality plan for the area includes "the most stringent measures that are included in the implementation plan of any State or are achieved in practice in any State, and can feasiblely be implemented in the area."

An extension does not extend the time for submission of an Attainment Demonstration SIP, in fact, the Attainment Demonstration SIP must have been submitted at the time the extension is sought. Thus, an extension does not avoid the necessity of the District's formulating and adopting a control strategy now that demonstrates how the air quality standard will be achieved. It merely postpones the date by which those control measures must be fully implemented and effective. This proposal has not been exhaustively discussed as an alternative because it is does not avoid any unmitigable significant environmental effect caused or potentially caused by the Proposed Project. Moreover, it does not achieve the project objectives, especially the objective of achieving attainment of air quality standards "without substantial delays." Finally, the District concludes that implementation of the Proposed Project is practicable by the current attainment deadline. Therefore, an essential precondition to a grant of an extension cannot demonstrated, and for that reason obtaining such an extension is not legally feasible.

7–1.3.9 Natural Events Policy Under Section 188(f) of the Clean Air Act

The City of Los Angeles proposed that the effect of the federal EPA's Natural Events Policy and Section 188(f) of the Clean Air Act be analyzed as an alternative to the Proposed Project. The federal Natural Events Policy is an policy decision of federal EPA that permits the EPA to disregard exceedances of PM_{10} standards which are caused by nonanthropogenic (i.e, not man caused) events, such as unusually high winds. The policy requires that the emission source be controlled by the best available control measures (BACM) and that it is shown that the exceedances to be disregarded overcame a control strategy implementing BACM. Further, the policy states that what constitutes "unusually high winds" is a determination to be made in the first instance by the local jurisdiction, in this case, the District.

Section 188(f) of the Clean Air Act authorizes the federal EPA Administrator to waive a specific date for attainment of PM_{10} standards in serious nonattainment areas, if the Administrator determines that nonanthropogenic sources of PM_{10} contribute significantly to the violation of the PM_{10} standard in the area. Substantially all of the emissive areas of Owens Lake are anthropogenic, since the City's continuing actions in diverting waters from the Owens Lake watershed have exposed those emissive areas to wind erosion, which areas in the absence of such diversions, would be wet and nonemissive. Nonanthropogenic sources of PM_{10} do not significantly contribute to the failure the Owens Valley Planning Area to attain the PM_{10} standards. Seeking a waiver under this provision is not treated exhaustively as an alternative since, as shown, obtaining a waiver of the attainment deadline under this provision is not legally feasible. Moreover, it does not achieve the project objective of achieving attainment of the PM_{10} standards "without substantial delays."

With respect to the Natural Events Policy, the control measures incorporated in the Proposed Project have been designed to attain the PM_{10} standards when winds speeds are at or below an hourly average of 40 miles per hour. Winds speeds above that are deemed by the Attainment SIP to be "unusually high winds" within the federal EPA's Natural Events Policy. The Natural Events Policy is not treated exhaustively as an alternative since its application to the Proposed Project does not avoid any unmitigable significant environmental impact caused by the Proposed Project, nor does it avoid the federal legal mandates that the District promptly adopt and order implementation of an air quality control strategy that demonstrates attainment of PM_{10} standards.

7-2 SUMMARY OF PROJECT ALTERNATIVES

The Project Alternatives to the Proposed Project consist of plans for the implementation of one or more of the selected PM_{10} control measures over the Owens Lake playa which when implemented would individually, or in combination, meet the goals and objectives of the *Owens Lake PM_{10} Planning Area Demonstration of Attainment SIP* (GBUAPCD, 1997a). The purpose of this analysis under the California Environmental Quality Act (CEQA) is to determine whether there are alternatives to the Proposed Project which both (a) substantively achieve the basic objectives of the Proposed Project, and (b) avoid any adverse environmental effect of the Proposed Project which is significant after mitigation. Theoretically, an almost limitless number of control measure combinations or permutations could be conceived as Alternatives, but as a practical matter, it is recognized that some of the control measures would be either technically infeasible in some parts of the playa, or otherwise would not be as appropriate as a different control measure in other parts of the playa. Similarly, each of the control measures are constrained by unique resource, economic, and environmental considerations. Both the technical limitations and the unique considerations were evaluated during the Project Alternative selection process and used to develop a range of feasible Project Alternatives. The Project Alternative selection process and the environmental effects of the Project Alternatives were subsequently described and evaluated by the District and the findings of that assessment were presented in a *Project Alternatives Analysis* document (PAA) distributed to interested parties (GBUAPCD, 1996d).

Some of the applicable decision making criteria relevant to the specific control measures which were considered during the Alternative development process, included:

Flood Irrigation:

- Works most effectively in sand-dominated areas;
- Minimal on-site infrastructure;
- Minimal operation and maintenance;
- Requires flat topography to maximize lateral sheet flow and minimize channelization;
- May require some maintenance grading to remove channels and maintain flat surface;
- Easily converted to other measures;
- Has been extensively tested on Owens Lake;
- Has high PM_{10} control effectiveness.

Vegetation:

- May work in conjunction with or as a successor to flood irrigation and tilling;
- Requires removal of toxic soil salts and high salt laden groundwater;
- Works best in clay/silt areas that retain water;
- Requires fairly extensive on-site infrastructure;
- Requires fairly extensive operation and maintenance;
- Requires flat topography for irrigation.

Gravel Cover:

- Provides effective control of PM_{10} on a wide variety of lake bed surfaces and topographies;
- Can be used as a default or "in-fill" measure where other control measures cannot be practically implemented;
- Cannot be easily converted to other measures;
- Must be protected from possible sediment infilling due to flood irrigation, flash floods, or wind-blown sand.

Tilling:

- Works only in clay or silty clay soils;
- May require initial leaching of soil salts to allow formation of durable clods;
- Minimal infrastructure requirements;
- Easily converted to other measures;
- Dependent on weather conditions (wind, precipitation, temperature);
- Will require re-tilling every 1-3 years;
- Requires moderately flat topography for clod reformation irrigation.

Salt Flats:

- Works as a sump for waste water and leached salts down-slope from flood irrigation, vegetation irrigation, and tilling clod reformation;
- Requires adequate contained surface area to capture and evaporate excess drainage in order to prevent contamination of mineral deposits at the center of the lake;
- Not tested on Owens Lake, naturally formed salt flats have high surface protection values if crust is maintained in damp condition;
- Must be located down-gradient of other water-based measures.

Sand Fences:

- Works on all types of surfaces;
- Acts as a barrier to reduce wind speed and impede sand transport;
- Reduces wind velocity to below threshold in order to protect downwind surfaces from sediment loading and/or abrasion;
- Requires extensive access road system for ongoing operation and maintenance;
- Requires high level of maintenance;
- Does not provide enough PM_{10} control to allow placement near historic shoreline; sand fences must be placed toward the center of the lake bed.

Uncontrolled Deep Flooding:

- Works on all types of surfaces;
- Complete PM_{10} control if all emissive surfaces are covered;
- Uses very high amounts of water.